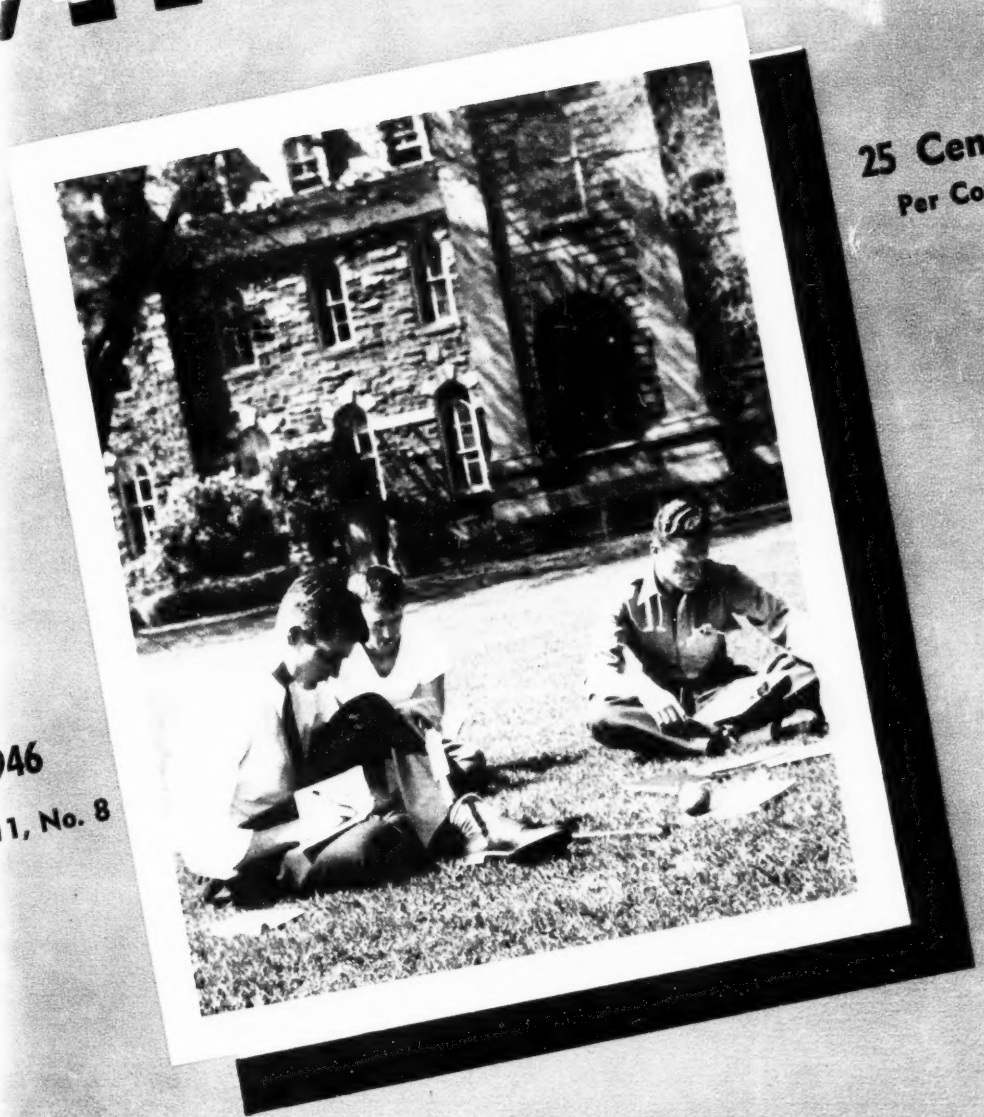
THE CORNELL ENGINEER



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Cover: Springtime in front of Sibley.

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This issue: May, 1946.

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ATOMIC ENERGY - BOON OR DOOM?

By EDWARD H. KERNER and ROBERT R. MEIJER

Members of the Staff of the Cornell Physics Department

"A house divided against itself cannot stand." These words, spoken by Lincoln almost a century ago, bear a message of peculiar importance for us in this atomic era, a message which we dare not neglect. That the world has become one house, that it has been divided for several decades, and that it has progressively been standing less and less stably—this is the meaning of two world wars in a single generation. Today, and forever hereafter, the possibility of swift destruction of the entire house must be reckoned with and it behooves us occupants, together with all other peoples of the same house, to begin to set our house in order and to secure its foundations firmly, lest we perish in an atomic catastrophe.

In this article we shall attempt first to explain the general principles of atomic explosions. We shall show that this is not "just another weapon," but a factor which must revolutionize our concept of war. We shall survey the possibilities of keeping the "secret" of the bomb, and of defending this country against possible atom bomb attack. We shall present our views as to how atomic energy can be made to serve as a boon to man, instead of being the agent by which our civilization commits suicide. And finally, we shall report on what scientists and engineers at Cornell and in other parts of the country are doing to educate themselves and the public on this subject.

How the Bomb Works

First of all let us review the presently held concept of the constitution of matter. All substances are made up of atoms, which in turn consist of three types of elementary particles: electrons, protons and neutrons. These have, respectively, a negative, positive, and zero electrical charge. The protons and neutrons are found in the small, heavy nucleus of the atom, while the relatively light electrons revolve in orbits around the nucleus.

All atoms of a given element have the same number of protons in the nucleus, but sometimes different numbers of neutrons, and hence different masses. Such differences are described by saying that the two materials are different "isotopes" of the same element. For eample, uranium 238 is a heavier isotope of uranium than uranium 235, because it has three more neutrons in its nucleus.

Some atoms spontaneously emit various kinds of "radiations." These are of three types:

alpha particles—a cohesive aggregate of 2 neutrons and 2 protons; i. e. a helium nucleus.

beta particles—electrons.

gamma rays—"light rays" of very high frequency, similar to X-rays.

The origin of all these radiations is the nucleus. Upon emission of either an alpha or a beta particle, but not a gamma ray, a different nucleus results; in this way atoms are transformed into new atoms.

Atoms emitting any of the above radiations are said to be "radioactive." We distinguish two kinds of radioactive atoms: (1) naturally radioactive atoms, (2) artificially radioactive atoms. The first kind is found with some abundance in nature; uranium, radium, and thorium are examples. Many of these naturally radioactive atoms are intimately related to one another. After one of these atoms has emitted its radiation, a new atom is formed.

The second kind of radioactivity is of special importance in understanding atomic energy. An atom not normally radioactive may be made so by bombardment of its nucleus with a suitable projectile, such as an alpha particle, a proton, or a neutron.

These artifically produced trans-

Photograph of atomic bomb test at Los Alamos .025 seconds after the bomb exploded. The extent of the blast is already more than 100 meters.

—Courtesy U. S. Army

formations, like all other transformations, are subject to the law of conservation of energy. In using the law of nuclear transformations, however, we must employ the Einstein mass-energy equivalence principle, E equals mc^2, in addition to the usual practice of describing only kinetic and potential energies. For example, if the sum of the masses of the resulting particles is less than that of the original particles for a given transformation, this transformation will liberate energy. In particular, the fission of uranium 235 releases tremendous amounts of energy, as will be seen below.

The role of neutrons in nuclear transformations is of special importance. Because they have no charge, they do not interact with either the atomic electrons or the protons in the nucleus. Hence they can penetrate more easily to the nucleus. Even neutrons with low velocities can interact with the nucleus and produce a transformation.

The fission of uranium 235 by neutron bombardment, referred to above, is of special interest because, in addition to releasing a large amount of energy, it releases several additional neutrons. If these strike other U-235 nuclei, rather than escaping into free space, they will produce other fissions, which in turn produce still others. This is called a "chain reaction." Hence it is clear that the mass of U-235 must be of a certain size, shape, and purity for such a continuous chain reaction to occur. It has been stated in the Smyth report,[1] which is the official account of the scientific research and technical development which went into the making of atomic bombs, that the critical mass, as it is called, for sustaining a chain reaction is between one and 100 kilograms.

Another interesting nuclear transformation is the bombardment of uranium 238 by neutrons. In this reaction U-238 is transformed by stages into a new element, plutonium 239. Plutonium is fissionable like U-235, and, moreover, is easier to separate from U-238 than is U-235, since it has different chemical properties.

We have said that the fission process releases tremendous energies. Let us see what this means. The fission of a single U-235 nucleus liberates about 3.2×10^{-4} ergs of energy. This is a very small amount of energy, but when we remember that there are 2.6×10^{21} atoms in one gram of U-235, we see that the energy released is immensely greater than that of any energy source hitherto used by man. More specifically, the complete fission of one pound of U-235 would result in the immdeiate release of 10.5 million kilowatt hours of energy. It is seen that even if the fission process occurs for only a few per cent of the U-235 atoms in a given mass, the energy release is still enormous. As a matter of fact it was stated that the Hiroshima bomb had an explosive power equal to 20,000 *tons* of TNT which is equivalent to an energy release of about 75 million kw.-hr.

If such figures seem a little too abstract to be vivid, let us consider the effect that such a bomb might have if dropped in the United States. A single bomb dropped over Manhattan Island would kill over one million persons directly, and completely destroy all property within a radius of at least one mile.

Of course an attacker would drop more than one bomb on New York. But a single bomb would more than take care of Ithaca. People from the Morse Chain Works to Cayuga Heights would never know what hit them. And the buildings of the town, the campus, and the surrounding residential areas would be completely destroyed.

This picture becomes more creditable when we realize that the first attack might easily consist of over 1000 bombs. Assume that only 750 of these escaped interception. Counting according to population alone, Ithaca would be about the 550th target on the list.

For a very graphic account of the bomb's destruction, we recommend Dr. Philip Morrison's report in the book *One World or None*.[2] He points out that the atomic bomb not only wrecks havoc through its explosion, but also kills additional thousands by the emission of deadly gamma radiation.

We have seen that the present atomic bomb is indeed a weapon to be dreaded. And we are led to believe that the efficiency of the energy release in later bombs can be increased. Hence future atomic weapons will doubtless be even more devastating.

Can We Keep The Secret?

We in the United States might, however, relax in a comfortable chair, puff complacently on a cigarette, and say that we don't have to worry because we are going to keep the secret of the atomic bomb. But there is *no* "secret of the atomic bomb." This is a popular myth which must be dispelled. Scientists and engineers have the primary responsibility of pointing this out.

First we must consider the facts that lead inevitably to the conclusion that there is no secret of the atomic bomb and secondly, we must point out the dangers that arise if this myth is not instantly dispelled.

What are the facts? First, almost all of the fundamental knowledge of nuclear physics that went into the making of the bomb was published in the scientific journals before the war and hence was available to scientists all over the world. Furthermore, the famous Smyth report[1] concisely tells the necessary fundamental facts and also gives additional information not previously published. This readily available information can be used by anyone.

It is not very difficult for scientists of any nation to make calculations from the present data or perform experiments and arrive at results concerning the construction of the bomb and the general processes involved that had been though to be secret.

The only "secret" now is some of the technology used in producing the bomb. Most of the experts who worked on the bomb believe that it will be only a short time, however, before at least some of the other nations will have produced an atomic bomb.

In *"One World or None,"*[2] Dr. H. A. Bethe, director of the theoretical division at Los Alamos during the war, and Dr. F. Seitz, who was with the Metallurgical Laboratory at Chicago working on plutonium, state that they "are led by quite straight-forward reasoning to the conclusion that any one of several determined foreign countries could

duplicate our work (on the atomic bomb) in a period of about five years."

Russia, for example, has tremendous resources both in materials and man power. Because of the nature of her political and economic state, she can devote much of her national energy to such a development. Nor is Russia the only nation which could produce the bomb in such a short time.

We must remember two more points. One is that England and Canada already have the "know how" of producing the bomb, because many of their scientists worked over here on the Manhattan Project. So the "secret" even now does not exclusively belong to the United States. The second point is that every nation in the world *now knows that the atomic bomb can be made.* This is important because when anyone attempts the unknown, half the battle is won if one is sure that what he is trying to do can be done.

For emphasis, we should like to repeat the words of Dr. J. R. Oppenheimer, who was the director of the Los Alamos Laboratory, in his recent testimony before the Special Senate Committee on Atomic Energy. Dr. Oppenheimer said "It (the atomic bomb) is no secret at all to the scientists of other nations. Its production by other nations is only a matter of time and no very long time at that, not more than a few years probably for some of them."

What About Defense?

Now that we have seen that there is no secret of the atomic bomb, another question immediately arises. Is there a defense against the bomb? The answer to this question is—yes—there is a defense against the bomb. It consists of completely dispersing the present population into very small units so that the concentration of people per unit area is extremely low, and of decentralizing our industries so that they are similarly dispersed, or moved many, many feet underground. This means that all the cities in the United States will have to become ghost towns. It means that all our workers will become moles, working far below the surface of the earth or working in small units widely separated which leads to a tremendous transportation problem.

Imagine such an industry as the Ford Motor Company having to produce under one of these two alternatives. Then consider the thousands upon thousands of industries in this country. It is clear that the dispersal of the population and the country's many industries is an extremely complex problem. It would be tremendously expensive and it is very doubtful if the people of the United States would ever agree to such extreme measures. Yes, there is a defense, but this scheme is so impractical that it scarcely constitutes a defense at all.

Damage at Hiroshima caused by the atomic bomb.
—Courtesy U. S. Army

Possible Countermeasure

Next, we ask, are there not countermeasures that can be used against the atomic bomb? There are several conceivable countermeasures. The first is to trip the fuse or detonating mechanism. Regardless of the weapon, these fuses are always relatively simple and tamper proof. It is next to impossible to devise a means whereby the bomb can be detonated by a defender, popular comic strips with their "death rays," or other devices, to the contrary. Many people including some in authoritative positions have made statements which lead to hopes of successful countermeasures. These have all been proved to be imaginative devices completely out of the realm of practicability. The next step then is to intercept the missiles. It is certain that in a future war, one of the forms that the atomic bomb will take is a rocket with an atomic warhead. It was seen in the last war that interception was indeed a difficult problem. When the V-1 bombs were launched by the Germans against England in July, 1944, more than 35% of the bombs launched struck London and did a tremendous amount of damage. This large percentage reached England despite the fact that England for almost a year previous was aware of the V-1 and had constructed defenses such as radar, fighter and anti-aircraft interception. Two months later, 9% were still reaching London despite the fact that many of the launching installations had been bombed out of commission. A sober consideration of the results had these bombs had atomic warheads is sufficient to shake even the most complacent of individuals.

A more terrifying picture is the V-2 with an atomic warhead. As far as we know it has been impossible up to now to intercept even a

(Continued on page 28)

Engineering At Cornell

15. The Industrial and Administrative Engineering Department

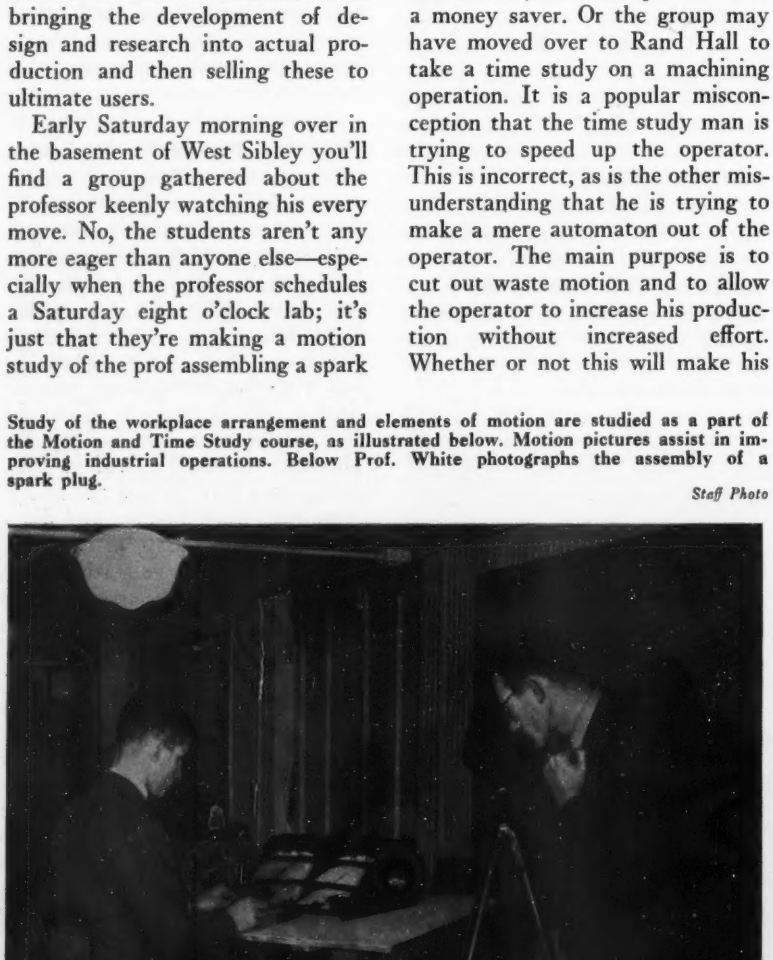
By EMMET WALLACE, AEME '46

The Administrative Engineer is trained to consider the broader aspects of industrial production. Although he has a sound engineering training, his objective is not design and research. He is concerned with bringing the development of design and research into actual production and then selling these to ultimate users.

Early Saturday morning over in the basement of West Sibley you'll find a group gathered about the professor keenly watching his every move. No, the students aren't any more eager than anyone else—especially when the professor schedules a Saturday eight o'clock lab; it's just that they're making a motion study of the prof assembling a spark plug. Watch his hands go through the "therbligs" of "transport empty to gaskets, select, transport loaded, position, and assemble." Such an analysis seems like a lot of foolishness at first, but it has proven to be a money saver. Or the group may have moved over to Rand Hall to take a time study on a machining operation. It is a popular misconception that the time study man is trying to speed up the operator. This is incorrect, as is the other misunderstanding that he is trying to make a mere automaton out of the operator. The main purpose is to cut out waste motion and to allow the operator to increase his production without increased effort. Whether or not this will make his pay envelope bulge a little more is determined by several factors. Two of the important ones are the policies of the Accounting and Labor Relations Departments.

Study of the workplace arrangement and elements of motion are studied as a part of the Motion and Time Study course, as illustrated below. Motion pictures assist in improving industrial operations. Below Prof. White photographs the assembly of a spark plug.

Staff Photo



Economic Planning

On the second floor of Sibley is found another class adding up long columns of figures and trying to make the books balance. After a couple of preliminary courses—one a general study of accounting and the other concerning the determination of the cost to manufacture and sell an article—the student finally arrives at a course called Standard Costs. With the other two as a basis, he learns how to use standard costs and studies the general control of production and sales through the records of costs. And if you think your monthly budgets are hard to determine what with variable beer parties and such, you should try to budget a $1,000,000 business with all its variables.

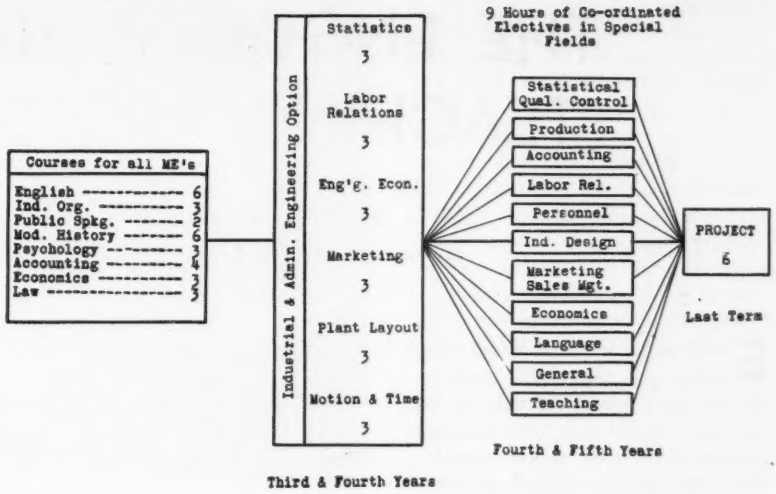
One flight further up in Sibley more students are to be found engaged in Plant Layout. This concerns just what its name implies—the layout of machinery in a plant. But it isn't just that. The student also studies the number of men and machines required and the type of materials handling equipment to be used, with an eye on both the hourly production to be met and the economy attained. The course is closely allied with Motion and Time Study.

Curriculum Content

These and many other courses go to make up the curriculum of the Administrative Engineer. Courses

in statistics, economics, personnel, business law, corporation finance, and production constitute his administrative option. Along with these courses he takes a great deal of mechanical engineering in order to acquaint himself with the means of production.

So we see that the training of the Administrative Engineer prepares him to be an important cog in the wheel of industry. Whereas the mechanical engineer analyses the stresses and strains in machines and materials, the Administrative Engineer analyzes the stresses and strains in production and human relations. Rather than the research and design of machines, he is primarily interested in the research and design of man's relation to man, man's relation to machines, and the relation of one machine to another.



A tentative five-year program for Engineering students taking the Industrial and Engineering Administration Option.

Dexter S. Kimball

The administrative program has been nurtured by Dean Dexter S. Kimball, the father of all this work. It is not too much to say that he was one of the pioneers in industrial engineering in this country. As a professor of Machine Design back in 1904, he gave birth to the program with a course entitled "Works Administration," which concerned the general problems of production. As Dean of the College of Engineering he was instrumental in starting many of the courses we have today. The book "Principles of Industrial Engineering" written in 1913 was a useful addition to the youthful field; while as President of the American Society of Mechanical Engineers, Dean Kimball drew more attention to the importance of the industrial engineer as an integral part of production. Although just past four score years, he is still active as a lecturer.

Dean Kimball's growing child was given into the hands of Professor John R. Bangs, Jr., in 1932, who ably continued to develop the program. At this time it formally became known as the Administrative Engineering Department. The main purpose was to coordinate twelve to fifteen hours for mechanical engineering seniors to take as an option, rather than have them take scattered courses which were not particularly inter-related. The program as set up today was planned by Professor Bangs.

However, the growth does not stop here; from babyhood through adolescence, and now to manhood. The program is now in the very able hands of Professor Harry J. Loberg, who heads the newly named Industrial and Engineering Administrative Department. Recognition of the importance of the training is manifest from the fact that it will be a five year course leading to a BME degree. The five-year program will be compulsory for all students except veterans this fall, but will be compulsory for everyone in the fall of 1947.

Tentative Program

A tentative outline for the administrative phase of the five-year program is shown in the diagram. Looking at the diagram, you will see that there are several important ideas which have been suggested. First and foremost, the five-year course means that the student will be able to take almost two terms of courses in industrial engineering. coordinated so that the student may see how one is related to another. For instance, Motion and Time Study will be related to Labor Relations. In the past, the aspect the effect Motion and Time Study had on a machine operator had not been amply considered.

As in the past the student will take his basic engineering courses. It is seen from the diagram that the curriculum is the same for all mechanical engineers during the first two years. With these basic courses under his belt, the industrial engineer will branch out into his option in his third and fourth years without concentrating on any particular aspect; eighteen hours are required. Then during his fourth and fifth years he will elect nine hours in any special field to which he has a particular leaning. It is felt that many students, by the time they have completed three years of training, will know fairly well what kind of work they plan to do upon graduation. And if they have no particular bent, they may elect three hours in

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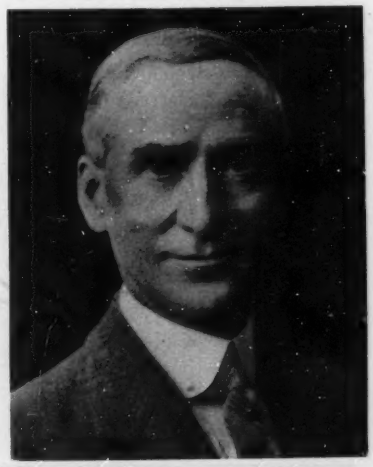
Dexter S. Kimball, Pioneer of Industrial Engineering Education.



THE ENGINEER AND THE TEACHING PROFESSION

By DR. LYNN A. EMERSON

Assistant Director of the Industrial and Labor Relations School

EVER since the first engineering college was organized, some engineers have found suitable outlets for their abilities in the teaching profession. Within recent decades, the scope of educational activities demanding trained engineers as teachers has been widening. Engineering colleges have increased in numbers and in size. Technical high schools have come into being. Vocational industrial high schools in increasing numbers have called for engineers to teach the related mathematics, science, and drawing. Technical institutes have employed many engineers. Hundreds of others have found satisfaction in teaching mathematics and science in the public high schools. The ranks of supervisors and administrators of educational programs hold many engineers. It is the purpose of this article to outline some of the fields in which engineers have served the educational profession, and the type of person needed for success in these jobs.

The job of a teacher is to help students to learn. It is not merely to stand before a class and lecture, or make the rounds of students at drafting tables and correct errors, or to supervise the work of students in the laboratory or shop. It is not merely assuming the role of a fountain of wisdom flowing in an endless stream. It is a task which requires a combination of technical knowledge and understanding along with a liking for people, and skills in helping students to learn. Some folks have the idea that to be a teacher all one needs to know is his subject. This of course is essential. But in addition, the real teacher knows people as well as he does his technical subject matter. And he knows the skills in getting across to the learner those things he needs to acquire.

The objectives of education include knowledge and understanding, skills and abilities, attitudes and appreciations. The real teacher must recognize these objectives and attain them in his students. If he is to do this, he must understand the basic principles of learning, and those of teaching. To get a student to feel responsibility for his acts requires a different teaching approach from that useful in teaching mathematical principles or shop or laboratory skills. The good teacher knows these differences in learning and teaching situations and uses the methods best suited to the task.

He understands the basic psychology underlying how students learn, and what conditions help or hinder learning. He knows that one student differs from another in ability to grasp new ideas, in dexterity in handling equipment, in emotional response, and in many other aspects. And he adjusts his teaching to take these differences into account.

The engineer who gets into the teaching field must develop these abilities if he is to be a good teacher. Today many engineers are finding satisfaction and are rendering effective service as good teachers. Some pick up their knowledge, understanding, and skill in the teaching field as they go along. Others prepare themselves as adequately as possible before starting their teaching, through organized courses in education or through professional reading, or in other ways.

Qualities of a Good Teacher

One may ask what are the characteristics of the engineer who is a good teacher. There is no fixed pattern, for one good teacher may be very different from another. Yet there seem to be certain things that are common to all. Among the most important is a liking for people of the type the engineer-teacher finds

THE AUTHOR

After his graduation from the U. of Minnesota as an EE in 1911, Doctor Lynn A. Emerson engaged in graduate work at the U. of Chicago and at N.Y.U., where he received his Ph.D. in 1932. In 1938 he came to Cornell as Professor of Industrial Education. During the war, Dr. Emerson was appointed Director of the National Defense Curriculum Laboratory in Ithaca. Recently he was appointed Assistant Director of the Industrial Labor and Relations School, in charge of the extension department.

Photograph illustrating use of laboratory equipment as an aid in student instruction.

in his classes. Some get along well with students of high school age. Others prefer to work with college students, or with graduate students. There are some differences in these groups, and a teacher might get along well with one group and not so well with one of a different type. But whatever group he works with, he must like to work with them if he is to be a real teacher.

The real teacher must be a person of considerable patience. He must be ready to teach the same principle or skill over and over again, for some students learn slowly. He must not get impatient with these slower learners but must be able to explain things in various ways until he finds the way that gets the idea across to the learner.

The teacher must also be a manager of the group he is teaching. He must be skilled in holding the attention of many learners in a classroom and of so managing his shop and laboratory that each student has his station and his assignment. Organization, order, and smooth operation are earmarks of the good teaching situation.

As one looks back upon the various teachers under whose influence he has come over the years, perhaps certain ones stand out. Often these are the teachers who took a personal interest in the welfare of each student. In addition to performing well the task of teaching, these persons found time to deal personally with those in their classes. And effective learning was the result.

Secondary School Teaching

In the high schools of New York State which normally enroll nearly three quarters of a million students, about one hundred thousand students are in industrial and technical courses of vocational character. Engineers in considerable numbers are found in these schools, teaching the sciences, mathematics, and drawing related to the various trades, and the technical courses. The State has set up licensing requirements for these teachers in terms of technical training, technical experience, and professional courses in education. To be eligible for such a license the applicant must have completed a four-year program in engineering or applied science, have had three years of approved and appropriate experience in industry, and must have completed six semester-hours in professional education. Within the first three years of teaching he must complete an additional twelve semester-hours of educational courses. This is usually done through summer sessions or extension courses. The license granted for this preparation is valid for a ten-year period. Twelve semester-hours of additional preparation are required for a permanent license.

For the past ten years, Cornell has offered the courses needed for technical teachers, through summer session courses and those offered during the regular school year, in the School of Education. During the coming year it is planned to expand the extension offerings so that more courses will be made available to persons now employed in teaching and others who may desire to enter the teaching profession.

Engineers and the Technical Institutes

A more limited number of engineers have found employment in the technical institutes, those schools which require high school graduation for entrance and which usually provide two years of applied technical training. Recent legislation provides for the establishment of five new technical institutes to be operated by the New York State

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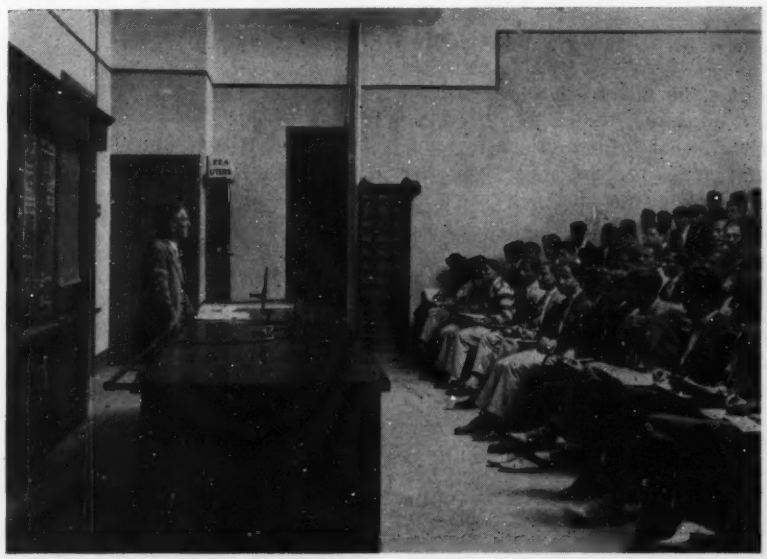
The lecture method may also be used for instruction.



The Forum

[1] Engineering Education

Edited by MILTON S. GROSS, ME '46

IN order to stimulate discussion of certain problems and trends which affect the engineer both in school and in the field, the CORNELL ENGINEER in future issues will publish the comments of prominent faculty members and students. We feel that the publication of these comments will do much toward the general enlightenment and guidance of our readers.

The problem discussed below was presented in the form of a question as follows:

"By a gradual process of evolution, should engineering education be offered on a graduate school level similar to Law or Medicine? Should engineering schools eventually require two or three years of a Liberal Arts education as a prerequisite for admission in an attempt to produce not only a more qualified engineer, but a more useful citizen?

We realize that this broad question may be attacked from many viewpoints; that it is impossible to present a complete study of this question in one article.* What appears below, therefore, is not a solution of the problem, but a discussion of the many factors with which our educators are confronted when they attempt to revise engineering curricula in accordance with the demands of our changing times.

FRANK O. ELLENWOOD
John Edson Sweet, Professor of Engineering

If your first question means that *some*, but not *all*, institutions should offer engineering work to graduate students only, my answer is "yes"; because such institutions can then plan on a limited number of superior students for whom the proper staff and equipment can be provided to enable real graduate work in engineering to be done.

If the question means that *all* institutions should confine their engineering instruction to those who have previously obtained a bachelors degree from some liberal arts college, it then becomes substantially the same as your second question to which my answer is "no" for the following reasons:

1. Many students, who graduate from the schools of electrical and mechanical engineering, find it worthwhile to spend two or three years after graduation in a large manufacturing plant, and at the same time, continue to study advanced subjects. This work is often better than that which would be offered by many engineering colleges and it cannot be duplicated by them.

2. For many young men, the time and expense of two or three extra years in college are of such importance that many of them will properly conclude that they cannot afford to obtain their liberal arts education before entering their engineering college.

3. Most of our engineering colleges, at the present time at least, are certainly not supplied with the endowment, the equipment, or the staff required to give real graduate work in engineering to *all* of their students.

4. It has certainly been true in the past, and probably will continue to be so, that many students have neither the inclination nor the ability to do real graduate work in engineering, and it would be wasteful of our time to try to make all of them attempt such work.

5. As far as the engineering training of students at Cornell is concerned, the five-year curriculum which is about to start will, in my opinion, afford the best solution to the whole question. Even with our present system of engineering education, the results have been extremely satisfactory when the *usefulness* of our engineers is compared with other citizens, whether we are at war or at peace.

STANLEY L. SCHAUSS
Asst. Prof. of Electrical Engineering

Graduates of engineering colleges are commonly criticized for an alleged lack of knowledge of the finer things of life, for an ignorance of the origins and the development of our form of civilization, and for an unawareness of their place in that civilization. Rarely, if ever, are engineering colleges charged with failure to produce graduates of acceptable technical ability.

Engineering colleges want to give their students the best training possible in the time available, and they want that training to constitute at least the foundation of an education. To broaden the mental horizons of tomorrow's engineers, curricula are being revised to give greater recognition to such subjects as history, English, economics, and psychology. But surely (and this is sometimes overlooked) engineering colleges must continue to provide sound technical training. Therefore, one wonders just how far engineering curricula should be revised in the direction described.

My own feeling is that Cornell, in offering a five-year engineering course in which cultural subjects and technical subjects are studied concurrently rather than consecutively, is making a really progressive change. But to a proposal that two or three years of liberal-arts training be required for admission

*Contributors were requested to limit their comments to approximately 300 words.

to an engineering college, I find two reasons for voting "No". First, a concentration of cultural subjects in the two years immediately following high school would probably fail of its objective because of the student's inadequate experimental background. Education is so much more than having gone to school; it requires having lived and being mentally alive. Second, one who is unable to spend six or seven years in colleges should not thereby be barred from engineering training if that is what he wants.

As the engineering sciences continue to develop, students in increasing numbers will continue their training on the graduate level. But there now appears to be no sound reason for offering engineering training only on the graduate level, as training in medicine and in law are offered. The relationships of physician and patient, and of lawyer and client are direct and unsupervised; the great majority of engineers work under the supervision of more experienced men. Under a system of licensing professional engineers just as physicians and lawyers are licensed, the interests of the public would seem to be adequately protected without requiring that engineering training be offered only to graduate students.

FRANCIS G. PAUL
ME '46

You have asked me a question that has been under discussion for quite some time with opinions both pro and con, however, I personally feel that it is not necessary at all to require two or three years of Liberal Arts education to produce a more qualified engineer. I firmly believe that a man or woman of college age should be able to strike out on his own and pick up all the material incidental to his profession through his own reading. Every man striving to be an engineer should realize that he must be able to speak and write correctly. He also knows that he must have a working knowledge of the fundamentals of economics, psychology, industrial relations and other related subjects. Therefore, if he is industrious at all he will master these fundamentals without the benefit of formal instruction.

The person of college age is mature enough in most cases to be able to gain the qualities most essential for a more useful citizenship by participation in extra-curricular activities such as fraternities and sororities, athletic teams, clubs, etc. Doing things, meeting people and forming ideas are the only necessary prerequisites for better citizenship, and all the formal courses offered will not help. I feel that today too many people try to judge a person on the amount of formal education he has had rather than the personal qualities he has relative to the job he is doing.

I will agree that a little more time could be spent on special engineering subjects according to the interest of the individual, but I do not think that it should be made compulsory. In a like manner, a Liberal Arts education should be left up to the discretion of the person, and by no means be a prerequisite to an engineering course.

JOHN S. CHRISTENSON
ChemE '47

"Graduates of engineering schools are full of theory, but have no practical understanding of their field." This is the general feeling of industrial men towards the college graduate. As a result of this feeling the average graduate spends several years doing only the dullest and most routine jobs in industry, at a salary comparable to that of the plant janitors.

It is my belief that an Arts school education will in no way produce a more qualified engineer. A study of History, English, French, Economics, etc., while it may produce a more broadened person, will be of no aid to a man when it comes to running a steam turbine or a cracking unit in an oil refinery. Such experience never has, and never will be obtained in any manner other than actual operation.

Engineering schools only offer the student a theoretical approach to their field, despite the fact that the greater majority of its graduates go into work of a practical nature. In my mind it is the obligation of educators and industrial men to collaborate with a view towards the adoption of a curriculum that will produce an engineer equipped with not only a theoretical background, but with a practical understanding of his field. Having worked in industry, I offer this plan for further study:

1. Following the first, second, and third years the student be required to work in his general field during most of the summer vacation.

2. Between the fourth and fifth year the student be required to take a full year off, during which time he will work in the specific field in which he shows the most interest.

It is my firm belief that these requirements should be as much a prerequisite for a degree as the maintenance of a minimum average is now.

Briefly then, engineering education should not be offered on a graduate school level but at least two years of industrial experience should be required for a degree and the entire present curriculum should be examined and the 'dead wood' eliminated.

The stand one takes on this issue depends upon his conception of what an engineering college is supposed to do. If one feels that the foremost mission of an engineering school is to prepare men intensively for one of the many highly specialized jobs in industry, then certainly the inclusion of any courses such as economics, history, government, English and philosophy are entirely superfluous.

But if one feels that engineering colleges primarily should teach students the fundamentals of engineering with emphasis on the thinking methods with which to work out the many applications, and secondly, to present to him the basis of thought in other fields of learning, then the inclusion of allied Liberal Arts courses begins to have some justification. Those who take this stand feel that the engineer both as a citizen and an industrial leader should have some knowledge of the history of the major social problems and current trends which are directly affecting him now.

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TEST EQUIPMENT FOR AIR CONDITIONING

By C. O. MACKEY

Professor of Heat-Power Engineering

NEW air conditioning apparatus has recently been added to the equipment of the Mechanical Engineering Laboratory and may be seen on the first floor of West Mechanical Laboratory. The new apparatus will be used for the instruction of undergraduate and graduate students in the fundamental processes used in the conditioning of air.

A novel feature of the equipment is the separate mounting of each unit of the apparatus on casters with lifting screws. Each unit is readily moved, and all units may be joined by wing bolts and wing nuts at the standard flanges of the air ducts. This design permits great flexibility in the order in which the different units may be joined in series to form the air channel; many different sequences of air conditioning processes may thus be shown by rearrangement of the same basic units. The units were planned by Professors Mackey and Wright and were built in the Maintenance Shop of the Department of Mechanical Engineering Laboratory with assistance from the Tin Shop of the Department of Buildings and Grounds. The five main units of the apparatus are described below:

Spray Chamber No. 1—this unit is an air washer of standard design with three rows of Yarway spray nozzles; one row of 6 nozzles sprays water parallel to the air flow; two rows of 6 nozzles, each, spray water counter to the air flow. Water is pumped through the spray nozzles by a ¾-h.p. Goulds Pump, and the water flow rate is indicated by a Rotamaster. A submarine light inside the spray chamber and a glass window permit observation of the sprays. This unit will have an ice tank with a water blending valve to control the temperature of the spray water; either ice water, recirculated water from the washer sump, or water from the main may be supplied to the spray nozzles.

Spray Chamber No. 2—an air washer with 2 rows of spray nozzles. Water is pumped through the spray nozzles by a ¾-h.p. Deming Pump. This unit will have a water heater of the steam ejector type with a water blending valve to control the temperature of the spray water; either heated water, recirculated water from the washer sump, or water from the main may be supplied to the spray nozzles. Water flow rate is measured by an Infilco rate of flow indicator.

Heating Coil No. 1—two rows of Type R Aerofin Coils supplied with steam for heating the air; the condensate from the coils falls into a weigh tank, and the states of the entering steam and leaving water are determined.

Heating Coil No. 2—similar to No. 1 but with one row of Type R Aerofin coil and one row of Type T Aerofin coil.

Coiling Coil—three-row direct expansion Aerofin Coil with 1½-h.p. General Electric refrigerating condensing unit using freon-12 as refrigerant.

Fan Unit—the fan is a Buffalo Forge Blower driven by a d.c. electric motor with field control; the variable speed permits an adjustment of the velocity of the air through the face area of the units within the range of 300 to 1200 ft./min.

Air Flow Control

There are several face and by-pass damper sections to place between the principal air conditioning units. Since there is a by-pass air duct in parallel with the air channel in each unit, the fraction of the total air flow which actually passes through the active part of each unit may be varied by adjustment of the manual face and by-pass dampers.

Instrument sections which carry dry and wet-bulb thermometers for the determination of temperature and humidity have been made as short, flanged sections which may

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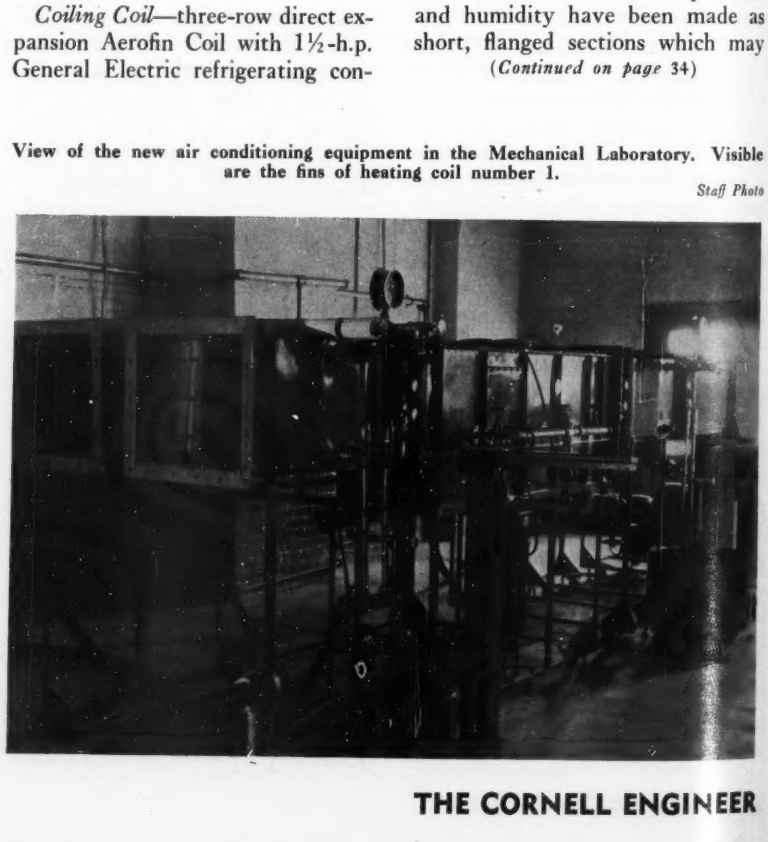
View of the new air conditioning equipment in the Mechanical Laboratory. Visible are the fins of heating coil number 1.

Staff Photo



NEWS OF THE COLLEGE

Appointments

THE appointment of Herman A. Lang to the rank of assistant Professor was announced by Cornell University recently.

Herman A. Lang, Mechanics of Engineering, has been an instructor at Cornell since 1942.

Professor Lang received his B.S. and M.S. degrees in Mechanical Engineering from the Massachusets Institute of Technology in 1942, and has recently been awarded his Ph.D. at Cornell.

Atom Bomb Observers

THREE members of the Cornell Aeronautical Laboratory staff in Buffalo will have important rolls in the atomic bomb test this summer in the Pacific.

Franz Allebach, Robert Kell, and Karl Swartzel, all members of the Laboratory's physics department, will fly from Buffalo to Bikini Atol in mid-April to spend approximately three months on the project which is under the direction of the joint Army-Navy Task Force 1.

Because of the highly technical phases of the "Cross Roads" test, the specific roles of the physicists have not been revealed.

Paper Published

A PAPER entitled "Strength of Thin Steel Compression Flanges" by George Winter, assistant professor of civil engineering at Cornell, appears in the current issue of the official publication of the American Society of Civil Engineers.

Professor Winter also presented a paper entitled "Hipped Plate Construction" at a recent convention of the American Concrete Institute in Buffalo.

Overseas Duty

FRANCES E. DART, instructor in the Department of Physics at Cornell, will go to Italy this spring to do relief work with the American Friends Service Committee. He plans to leave Ithaca in six or eight weeks, after completion of his work for the Ph.D. degree.

Dart expects to spend two years in Italy, working on the transport of building materials for the reconstruction of homes in the seriously devastated villages of Chieti province in the Aventino River Valley.

The project was started by the AFSC and the Friends Ambulance Unit last April. A plan was worked out whereby the villagers exchange firewood for brick, tile, and plaster. The brick and tile kilns are 30 or more miles from the villages and the AFSC 2½ ton trucks are used to haul the materials, often over badly damaged roads where all bridges have been destroyed.

Rations and gas are provided by the Allied Commission, and workers are lodged with Italian families.

Dart has been at Cornell since 1941. Earlier he received an A.B. from Oberlin College and an M.S. from Notre Dame. While in Ithaca, he has been scoutmaster of Troop 19 at Belle Sherman School.

Mrs. Dart and nine-month-old daughter plan to stay with relatives in South Bend, Ind., during the two year period.

Expansion

AN expansion of Cornell's admissions department to cope with the flood of post-war applications was announced today by President Day. He also stated that Herbert H. Williams would become director of admissions, effective immediately, and that Dr. E. F. Bradford will serve as director of the enlarged office of the registrar.

The expansion of staff and space for both the admissions and registrar's divisions is necessary to handle the correspondence and records of the thousands of inquiries and applications from veterans and civilian students.

During the month of January alone, the University received more than 4,000 inquiries, applications, and requests for applications.

The registrar's division will remain in Morrill Hall, taking over the space used at present for admissions. The admissions division will move to the basement of McGraw Hall where it will have nearly double the present space, and double the present staff.

A Cornell graduate in 1926, Mr. Williams, the new director of admissions, served as an engineer with the Port of New York Authority until 1933 when he returned to the University to organize the Placement Service. He has been director of the Service since its beginning.

During 1943-45 he also served as assistant to the dean of the College of Engineering as chairman of the McMullen Scholarship Committee and in charge of secondary school work.

A graduate of Bowdoin in 1912, Dr. Bradford has been director of admissions at Cornell since 1928 and registrar since 1932. He is also a member of the faculty.

Westinghouse Fellowship

THE establishment at Cornell by the Westinghouse Educational Foundation of a fellowship for graduate work in mechanical engineering was revealed recently by the University.

To be known as the Westinghouse Fellowship in Mechanical Engineering, the award will carry a stipend of $1,000 a year, for a period up to five years.

The candidate will be selected by the University from a list of applicants secured as a result of announcements sent to accredited institutions throughout the country.

duPont Fellowship

FOUR fellowships with a total value of between $8,000 and $10,000 have been awarded to Cornell by E. I. du Pont de Nemours & Co.

The highest ranking of the four fellowships, for postdoctoral work in chemistry, carries an annual stipend of $3,000 for the Fellow, with an additional grant of $1,500 for the University.

Three postgraduate fellowships, one each in chemistry, chemical engineering, and mechanical engineering, carry annual stipends of $1,200 for an unmarried student, or $1,800 for a married student.

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PROMINENT

Randy

J. Randall Gritzan, CE

RANDY, sometimes known as "The Beaver," graduated from high school early in June, 1943, and several weeks later was on his way to college. When he left his home in Montclair, New Jersey, he was not, however, headed for Cornell, but for M.I.T.

While there, his activities consisted mainly of repeated trips to Wellesly College and frequent walks over to the draft board. After appealing to the board in vain three different times, he finally left for Sampson Naval Training Station, after completing one term of college. During that time he had become a member of the Kappa Sigma fraternity and had made the Dean's list.

After four months' "vacation" at Sampson, he was sent to Cornell. He too was blessed with that infamous ride on the Black Diamond. Life on the hill in V-12 was not as easy as he expected and after two days in Ithaca, Lieutenant Smith had him slated for a weekend restriction. This weekend, however, was spent by drinking beer in one of the better places in Ithaca. (The "Green Lantern" we presume.)

After several weeks Randy became rather disappointed in Ithaca life and ever since has spent almost all his Saturdays and Sundays out of town. He has quite a weekend hitch-hiking record, having hitched from Ithaca to Buffalo, Albany, New York, Olean, Oswego, and Erie on various occasions. Much of his spare time is usually spent "in the sack," or else working on his 1928 Chevy which doesn't seem to move too fast or too often.

While at Cornell he became interested in the CORNELL ENGINEER and spent two terms as treasurer of that publication. He also represented his class on the Civil Engineering Honor Committee for three terms, and is a member of the student chapter of A.S.C.E. He was recently elected to "Chi Epsilon," civil engineering honor society. One of his greatest pastimes is playing the piano. Numerous times he has helped out at smokers and variety shows by doing his share of the musical entertaining.

After receiving a B.C.E. degree in June, Randy plans to stay in the Navy for a while as an ensign. Following that in his plans is a long—quite long—vacation and then maybe a post-graduate course in some phase of Civil Engineering. "These are my plans," says Randy, "but there's no way of telling what I'll *really* be doing this time next year."

Ralph C. Kelley, Jr., EE

One of the biggest secrets of his life had been that the "C" in Ralph C. Kelley stands for "Clemson," a monicker of ancestral origin. Now it's out, though, and he hopes that it won't be held against him.

"Kelley's" biggest day was on December 18, 1924. He claims he remembers every minute of it and was quite disappointed that there was no birthday cake for him. He was born in Frankfort, Indiana, and lived in Indianapolis for a few years; thence to Peoria, Illinois, for the grades; and then back again to Indianapolis. In his junior year of high school the Kelley family again moved, and they now live in Philadelphia, so it is evident that Ralph has seen a few schools in his career.

Although he played varsity basketball in Cheltenham High his senior year, he managed to graduate well up in his class and take part in the various extra-curricular activities. He graduated from Cheltenham in 1942 and says that it was quite a coincidence that the yearbook had him slated for Cornell, because he enrolled in Lehigh University in the fall of '42. However, one week before classes began, family sickness changed his plans, and he decided to go to work.

Starting at the bottom as a clerk in the Midvale Company's chemical control laboratory, he eventually moved into the more interesting phases of the work. In thirteen months he had learned how to run most of the analyses and was engaged in experimental work involving the use of the electrophotometer in colorimeter analyses, when the Navy beckoned. He remembers particularly the day everything went wrong at the plant. It seems that the open hearth division had all furnaces ready to tap and were yelling for the go-ahead, and at the same time, the electric furnaces were ready to pour. At this critical period the lab ran out of a chemical needed in the phosphorous and chromium determination. It was a mixture of hydrochloric acid and ammonium hydroxide, among other things. Ralph was elected to make up a batch right away. But in his excitement to rush the process through, he forgot all about the idiosyncrasies of glass jars when heated at an extreme rate. The next thing he knew a five gallon glass jar was ready for the scrap pile,

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Ralph

ENGINEERS

John P. Craven, CE

WE'RE in the Straight—anytime and that boy is at it again. Seven No Trump-Doubled-Redoubled. That's simple of course, for that's "J. P." Craven playing Culbertson again.

John hails from good old Brooklyn, a city that has made the headlines more than once. After graduating from Brooklyn Technical High School he went to work for the National City Bank and attended night sessions at Brooklyn College as an English Major. It is rather amusing to find that John once turned down a position with Bell Laboratories because he wasn't interested in Engineering.

John arrived at Cornell in July of 1944 fresh from the decks of the U.S.S. *New Mexico*. When asked for a few salty yarns the best John could do was to tell of his battle station, the fifth auxiliary stearing station, and how he fell asleep there during the invasion of the Marshall Islands.

John soon became involved in many Cornell activities, being an active member of the Sage Chapel Choir and though it shouldn't be mentioned in the same sentence, he has quite an adequate knowledge of party songs. Elected to Tau Beta Pi at the end of his third term at Cornell he now is corresponding secretary for that organization. He is also the secretary-treasurer of Chi Epsilon, Honorary Civil Engineering scholastic society, and an active member of Pyramid, a Civil Engineering social society.

Known to most of his friends as "J. P.," he has become quite an important figure in the Civil Engineering school.

"J. P." will be graduating from Cornell and from the Navy in June. He plans to do some sort of engineering work this summer and then go to graduate school in the fall. After securing his master's degree John hopes to get into some field of Hydraulics.

When John was asked how he happened to get into the C.E. school he explained that he had to take some course when he arrived at Cornell and he just seemed to drift into the C.E. school. It would seem to all outward appearances that it was quite a drift from the courses in Literature into the mysteries of calculus and the famous engineer's slide rule.

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J.P.

Milton S. Gross, ME

"Hi, Milt!" and a broad smile greet Milt Gross wherever he goes, proof of a well-known and well-liked prominent engineer. A veteran, Milt came back to Cornell in November of last year, a month after being discharged. Besides doing good work in the M.E. School, he entered activities with the initiative and energy so characteristic of all he does. The fates were indeed kind when Milt decided to join the *Cornell Engineer*. As an enthusiastic board member, he gave the magazine "a shot in the arm" with his new ideas and the force to carry each project through. Quick to recognize his talents, the board elected him Assistant Editor this Spring. When the Managing Editor was drafted recently, Milt took over and is now capably handling both jobs of Managing and Assistant Editors.

Milt is claimed first by Utica,

Milt

where he was born in 1920. His original contacts with engineering came at an early age through the factory his father owned. In 1934 the whole family moved from Utica to Rochester, where he graduated from Monroe High School. Milt might be considered the black sheep of his family because he refused to follow the precedent set by his brother and sisters by going to Syracuse University. Instead, what Syracuse lost Cornell gained. Well-fortified with a State Scholarship and a Cornell tuition scholarship, Milt enrolled in the Arts College in 1938. His original purpose was to complete an Arts-Engineering course of six years because he was convinced, and still is, that engineers should have a more liberal education. However, the quickening world pace upset his plans; and in 1940 he transferred to the M.E. school. Until 1942 Milt was kept pretty busy, to say the least, with twenty-two hour term programs. The inevitable happened in '42, when Milt joined the Army Air Forces. At first he was stationed with General Electric in Lynn, Massachusetts, where the turbosupercharger was developed and produced. His work with G.E. at Lynn gave him the information and experience to write a very keen and thorough article on "The Development and Performance of the Turbosupercharger," published recently in the *Cornell Engineer*.

But Milt wanted to fly, so he signed up for air crew training. After the extensive tests, he was classi-

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ALUMNI NEWS

ALFRED W. MELLOWES '06 M.E., is president and general manager of The National Lock Washer Co., 241 East Erie Street, Milwaukee 2, Wis.

PERCY S. LYON '12 M.E. is president of C. H. Wheeler Manufacturing Co., Nineteenth and Lehigh, Philadelphia, Pa. He lives at 3416 Warden Drive, Philadelphia, Pa.

JOHN M. DEMAREST '13, '14 C.E. has been appointed vice-president and works manager of Marion Steam Shovel Co., 420 Lexington Avenue, New York City. He was previously controller and manager of the Paterson, N. J. plants of Wright Aeronautical Corp.

HENRY W. WILEY '16 M.E. is publisher of the new magazine *Holiday* published by the Curtis Publishing Company. He is a member of the *Alumni News* advisory board, and has been assistant to the advertising director of the Curtis Co.

SEYMOUR W. FERRIS '21, '22 B.Chem. has joined the development division of the Sun Oil Co., in Marcus, Pa.

WILLIAM W. SCULL '24 M.E. has been appointed production manager of plants of the B. F. Goodrich Chemical Co. in Akron, Ohio. Since joining the company he has been plant manager of two of the government to the Washington office of ated by the company in Kentucky and Texas.

COMMANDER LEO K. FOX '25 M.E. is chief of the maritime branch of the Office of the Foreign Liquidation Commissioner in Paris, France. He served with the Navy Department Bureau of Ships until assignment to the Washington office of the Foreign Liquidation Commission.

RICHARD SEIPT '32 M.E. is vice-president in charge of sales with the Laminated Skim Co., Glenbrook, Conn.

H. ALFRED STALFORT, C.E. '34, project manager for the Consolidated Engineering Company, Baltimore, Maryland, was recently elected president of the Building Congress & Exchange of Baltimore, which is the local association of the building industry and includes contractors, architects, engineers, building supply dealers, and subcontractors.

GEORGE W. DARLING, Chem.E. '37, has been since April a technical research assistant in the research analytical laboratory at Hooker Electrochemical Company.

LIEUTENANT COLONEL LEON H. MCCURDY '34 M.E. has been appointed chief of operations at Maxwell Field Separation Base, Montgomery, Ala. He was former director of photo reconnaisance for the Ninth Air Force and was a flying instructor during the early part of the war. He received the French Croix de Guerre for low-flying photo reconnaissance at St. Lo to obtain pictures for the information of General Bradley's armies.

CAPTAIN CHARLES C. SPENCER '35 C.E., Army Sanitary Corps, has returned to the United States after completing a tour of duty in Brazil, where he served as a technical helper to the government in overcoming health problems in the Rio Doce valley. Two years ago he was assigned to the Institute of Inter-American Affairs health and sanitation division whose health experts joined with Brazilian medical and public health men to control diseases in the Rio Doce valley. The diseases were hindering the flow of vital war materials, especially iron ore. The group succeeded in protecting the health of workmen on the Vitoria-Minas railway.

FRANK D. NEWBURY '01 M.E. (E.E.) has been elected to the board of directors of Westinghouse Corp. He had been a vice-president of the company since 1941. During the war he was head of the emergency products division, which was responsible for the manufacture of special war equipment. He also coordinated the work of three Ordnance plants operated by the Corporation at Louisville, Ky., Canton, Ohio, and Center Lane, Mich. He lives at 577 Briar Cliff Road, Pittsburgh, Pa.

DANIEL P. ORCUTT '07 M.E. retired April 1 as manager of the New York branch of The Electric Storage Battery Co. He had been with that company for the last thirty-six years, and had been in the storage battery field since graduation. He resides at 820 Carlton Avenue, Plainfield, N. J.

GEORGE P. JESSUP '08 M.E. has joined Western Contracting Corp., Sioux City, Iowa, after having been with the Tennessee Valley Authority for the past eleven years. Jessup built almost a dozen of the big dams in the United States, the largest being Kentucky Dam, which will be completed in 1947 at Gilbertsville. He also built the Guntersville and Wheeler dams on the Tennessee river. His first job for Western Contracting Corp. will probably be overseeing the building of a dam in the Middle West.

RANDOLPH W. WEED '09 M.E., 441 Lexington Avenue, New York City, is vice-president of Detroit Steel Products Co., Detroit, Mich.

HARRY E. MATTIN '18 B.Chem. is chief executive of Mearl Corp., New York City, which has been awarded the Navy Certificate of Achievement for its efforts in support of the war production program. The company manufactures fire extinguishing material and equipment for the Navy.

JOHN W. WEIGHT '18 M.E. has been appointed manager of the New York branch of The Electric Storage Battery Co., succeeding Daniel P. Orcutt, '07, who retired April 1. Weight joined the company in 1920; in 1944 he took charge of railway

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Cornell Society of Engineers

107 EAST 48TH STREET 1945-1946 NEW YORK 17, N. Y.

J. PAUL LEINROTH, *President* ....37 The Fairway, Montclair, N. J.

ROBERT B. LEA, *Executive Vice-President* ....Great Neck, L. I., N. Y.

PAUL O. REYNEAU, *Secretary-Treasurer and Representative, Cornell University Placement Service* 107 East 48th St., N.Y.C.

KARL J. NELSON, *Recording Secretary* .....4 Tulip St., Cranford, N. J.

FURMAN SOUTH, JR., *Vice-President*.....1140 Wightman St., Pittsburgh, Pa.

WILSON S. DODGE, *Vice-President*.....327 Montgomery St., Syracuse, N. Y.

CREED W. FULTON, *Vice-President* .....4200 Wissahickon Ave., Philadelphia, Pa.

SYLVESTER J. McKELVAY, *Vice-Pres*.....174 North Arlington Ave., E. Orange, N. J.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

Mr. Leinroth

President's Message

With the war over and our hopes turning toward seeing the great plans for the future College of Engineering take actual shape, we get more and more satisfaction out of the knowledge that the College has acquired, through the munificent gift of the Curtiss-Wright Corporation, its great aeronautical laboratory. The more we learn of this gift and of how it came to Cornell, the more important it becomes.

While the selection of Cornell for the gift was indeed a personal triumph for Dean Hollister and those other Cornellians who had to do with bringing the laboratory to Cornell, it should be a matter of great pride and gratification to all Cornellians to know that their university was selected over other schools only after considerable and very careful study. The selection of Cornell should, therefore, go far to not only renew our faith in the high standing and prestige of the present College of Engineering as a technical school but should also strengthen our faith in its future. Viewed in that sense the gift of this great laboratory should have an important effect on the future plans of the College and be a potent factor in assuring the success of carrying them out at an early date. Thus besides offering magnificent facilities to the new Graduate School of Aeronautical Engineering the gift of the laboratory gets the College of Engineering development program off to a most auspicious postwar start.

In addition to the superbly equipped laboratory, which in itself represents a gift of millions of dollars, a very substantial working capital has been provided by interested Cornellians and others, which will make it possible for Cornell to render a great service to the entire aviation industry by making available unexcelled facilities for the carrying on of research and for the training of aeronautical engineers.

It has been stated before that to get the effective support from them which is so necessary, the alumni must be made to know of the accomplishments of the College and take pride in them. It should be one of the aims of the Society to disseminate such knowledge through an ever increasing membership. Such a noteworthy event as the acquisition of the Curtiss-Wright Aeronautical laboratory with all its implications should be brought home forcibly to them. We should not lose sight of the fact that the laboratory came to Cornell largely through the advantages of having Cornell being well presented by a group of well informed and enthusiastic Cornellians. We should have more of such groups. What a great thing it would be for the College of Engineering if the number of such groups could be multiplied many fold!

J. PAUL LEINROTH

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EDITOR'S NOTE:

This issue brings to the close another year of publication of the CORNELL ENGINEER. As we lean back in our collective chairs and scan the events of the year, we feel well satisfied with the magazine. We would like to take this opportunity of expressing our appreciation for the splendid cooperation of Mr. Leinroth, the Cornell Society of Engineers, and all those alumni who hvae contributed to the mazafiine. This magazine is, to a certain extent, your magazine as well as ours; and we depend upon contributions from the alumni for many of our articles. Therefore, we hope that during the next year we shall receive the same whole-hearted support from the President, the Society, and the alumni at large.

L.R.A.

Recent Developments In Engineering

Techni-Briefs

Resnatron

ONE of the important offensive weapons in the Allied invasion of Europe was a big, 500-pound electronic tube called the Resnatron. As Allied bombers took off, two of these tubes went into action to blanket the sky for several hundred miles ahead with a terrific barrage of short-wave static. The result was that German night-fighters on the lookout for the attackers found their radar receivers saturated with confusing blobs of light indistinguishable from the real targets flying behind the screen.

Today the Resnatron is being groomed for peacetime service in television. Because of the tremendous power it can generate in the ultra-high frequencies—at least five times more than the best tube previously developed—it holds great promise as a valuable component of television transmitters.

As a weapon of war, the Resnatron had to generate waves of billions of cycles a second over a bandwidth broad enough to cover all the frequencies on which German radar operated. It had to keep up this flow of energy without interruption, and it had to do it with sufficient power to cover thousands of square miles.

The Resnatron achieves its ultra-high frequencies by oscillating or "shaking" electrons until they move back and forth a billion or more times each second. The electrons are first emitted from twenty-four separate heated filaments. Traveling in bunches spaced only one ten-thousandth of a millionth of a second apart, the electrons reach a part of the tube called a resonant cavity. This is a hollow, copper-walled space that oscillates at a particular high frequency when excited by electrons traveling at the same frequency.

Here most of the energy is piped out to the antenna for transmission. The remainder, however, is channeled back into the circuit to help facilitate the flow of electrons at the proper frequency. The process is repeated over and over again a thousand million times a second.

Construction of the tube presented many problems, not the least of which was to remove the heat generated by collision of electrons with parts of the tube. More than 50 feet of copper tubing are used to carry water to cool the main tube elements.

Mesons Produced

USING X-rays from the 100,000,000-volt betatron, released last October from wartime secrecy, physicists have succeeded for the first time in producing artificially mesons, one of the chief constituents of the cosmic rays continually bombarding the earth.

Hitherto known only through cosmic ray studies, the meson particle is considerably more massive than the electron, though lighter than the proton. Mesons are produced in the stratosphere by the primary cosmic radiation from outer space and last, on the average, but a few millionths of a second.

During the past five years physicists have carried on a series of experiments in which balloons carrying cosmic-ray detecting equipment were sent into the stratosphere. These demonstrated that cosmic-ray mesons are produced when the primary rays, each carrying an electrical charge, hit the nuclei of the air atoms far above the ground.

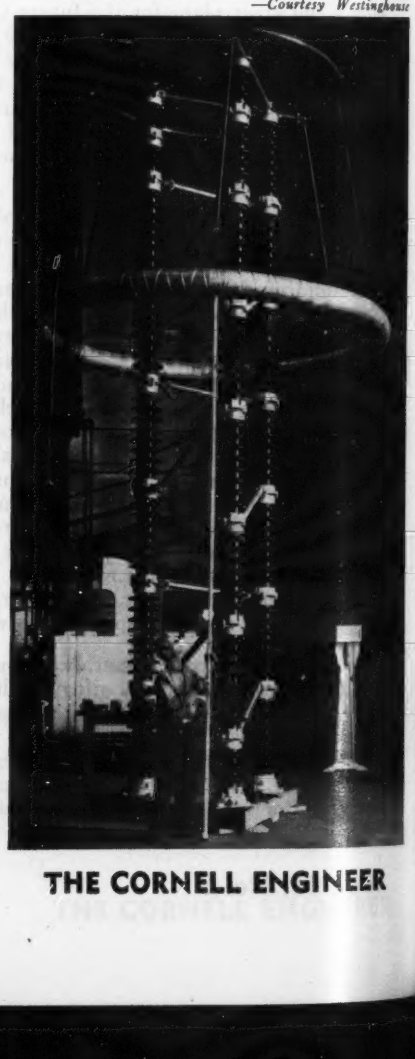
Though the typical meson has a mass about 200 times that of an electron, evidence has been found that there are some with as low as twenty electron masses.

Betatron

DIRECTLY opposed to the atomic bomb, which changes matter into tremendous force, is the new atom smasher, the betatron, which creates matter from energy. "Pair formation," as the creation of matter from energy is called, has been observed by scientists in their study of cosmic rays and the rays from radium and similar radioactive elements. When high intensity x-rays are passed close to the nucleus of an atom, the ray or photon may cease to exist. In its place are created a new electron and a positron, which is an electron with a positive instead of a negative charge. Very quickly the positron happens near another electron; the positive and negative charges cancel, and both disappear, producing radiation again. The new electron created in the pair has mass, like the positron, and is therefore a unit of matter.

Creation of the pair is shown in a "cloud chamber," in which a thread-like line of fog marks the track of an electron or positron. A V-shaped track, caused by the two particles, is visible when the pair is formed.

Lightning arrester designed to protect a 500,000 volt electric service line.
—Courtesy Westinghouse



Energy of a little over a million volts produces an electron pair at rest; higher voltages give the pair extra energy and higher velocity. Therefore, the pairs formed with the hundred million-volt betatron are the most energetic ever produced by artificial radiation.

New Lubricant

A NEW internal combustion engine lubricant having unusual advantages over mineral oil, particularly for cold weather use, has recently been developed. This lubricant, which is now being produced in commercial quantities, has properties quite different in many respects from oils derived from petroleum.

The lubricant can be manufactured to any desired viscosity and is wax-free. Pour-points vary from —30° to —80° F. Flash points range from 300° F. up. The new materials have densities approximating that of water. Carbon residue values are less than 0.01 per cent, regardless of viscosity. The lubricant is characterized by low change of viscosity with change in temperature, having viscosity indices in the range of 140 to 160.

Carbide's new lubricant contains no petroleum oils. Its use in internal combustion engines has been studied for several years in a large number of vehicles which have covered a total of over one and one-half million road miles. Large quantities are being used in military equipment.

These new lubricants practically eliminate sludge and varnish formation in the engine. Wear of the moving parts is comparable to wear experienced with ordinary mineral oils. Ease of starting in cold weather is an outstanding advantage.

There are indications that these lubricants will soon be widely used in internal combustion engines. These compounds are manufactured in two types, water soluble and water insoluble. The latter type is used for lubricating internal combustion engines. Other applications include lubrication of refrigerating machines and all kinds of machinery operated under conditions of low temperature or where a non-sludging oil is required, and as hydraulic fluids, textile lubricants, plasticizers, in leather treating compounds, wire drawing lubricants, and heat transfer liquids. Greases having unusual high- and low-temperature properties have been prepared from these lubricants.

—Courtesy Westinghouse

This detector, ferrots out small leaks in high vacuum systems such as are used in uranium production.

Radar Navigation

USING radar micro-waves speeding at 186,000 miles per second to give the pilot a constant indication of his position, an advanced new system of navigation for both civil and military flying has been developed.

At present the pilot does not receive a continuous indication of the plane's distance from the area being approached. Under the system developed by the Army Air Forces and General Electric, radar equipment in the plane constantly sends out radio waves of very high frequency, known as "micro-waves." They travel at the speed of light to a centrally-located radio beacon in the area which the plane is approaching. The beams are reflected back to the radar equipment, giving a continuous reading of the distance between the beacon and the plane.

If this new distance-measurement system were combined with a direction-finding system, the pilot would then have all the necessary information for complete navigation.

Roughness Measurement

USING a new device which determines relative roughness or smoothness, it has been recently proved that glass is some 300 times smoother than satin and some 475 times smoother than silk.

Though they may not have the "skin you love to touch," "dish-pan hands" by actual measurement are twice as smooth as satin and more than three times smoother than silk.

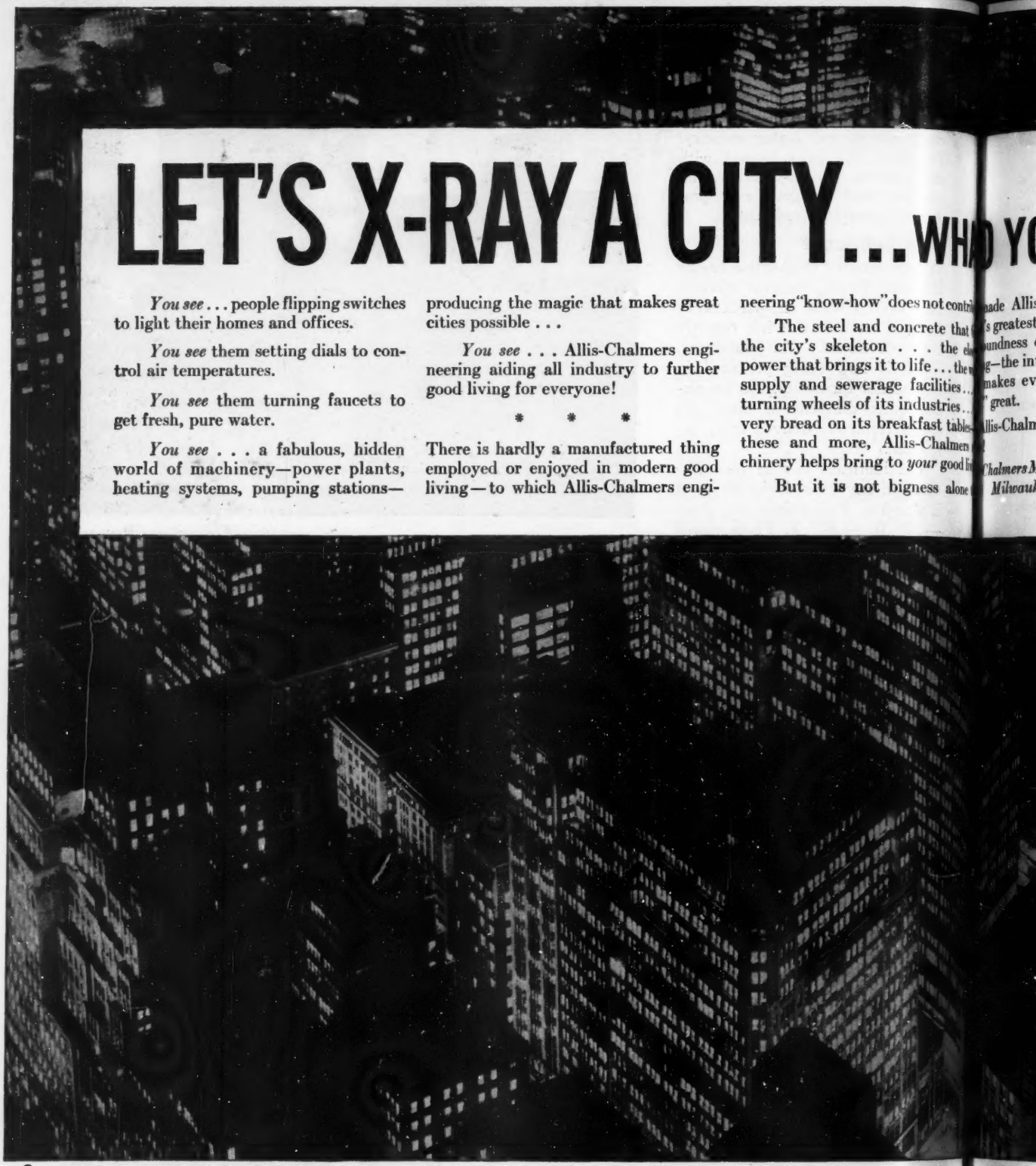
A highly sensitive device, which electrically "feels" each surface and makes its own measurements, was used in order to record ordinary windowpane glass as having only four 120 millionths of an inch deviation from "perfect smoothness."

The standard roughness specimens utilized are a series of ten metal blocks, representing 25 different surfaces and ten different degrees of roughness. The roughness ranges from only four millionths of an inch deviation from "perfect smoothness" to 2,000 millionths of an inch deviation.

Jet Propulsion

THE record smashing cross country flight of three jet propelled Lockheed P-80's, driven by jet engines at an average of nearly 600 miles an hour, gives proof that this new gas turbine motive force will soon be harnessed to propel large civilian transport aircraft at lightning-like speeds over long distances. Records

(*Continued on page* 40)



LET'S X-RAY A CITY...WHA YO

You see... people flipping switches to light their homes and offices.

You see them setting dials to control air temperatures.

You see them turning faucets to get fresh, pure water.

You see . . . a fabulous, hidden world of machinery—power plants, heating systems, pumping stations—producing the magic that makes great cities possible . . .

You see . . . Allis-Chalmers engineering aiding all industry to further good living for everyone!

* * *

There is hardly a manufactured thing employed or enjoyed in modern good living—to which Allis-Chalmers engineering "know-how" does not contri

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power that brings it to life . . . the
supply and sewerage facilities . . .
turning wheels of its industries . . .
very bread on its breakfast table
these and more, Allis-Chalmers
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But it is not bigness alone

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For the producer, distributor, or user of commercial electric power, Allis-Chalmers provides new and improved power generating units, transformers, unit substations, switchgear, control, circuit-breakers, switchboards, rectifiers, converters, regulators, motors, and scores of other electrical products. In electrical equipment, Allis-Chalmers is a good name to know.

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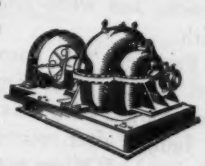

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STRESS and STRAIN...

Freshman (leaving Baker Lab): "What's that funny smell?"

Second Freshman: "That's fresh air, you sap."

* * *

Coed: "Do you love me with all your heart and soul?"

V-12: "Uh huh."

Coed: "Do you think I'm the most beautiful girl in the world?"

V-12: "Yeah."

Coed: "Do you think my lips are like rose petals, my eyes like limpid pools, my hair like silk?"

V-12: "Yup."

Coed: "Oh, you say the most beautiful things."

* * *

Passenger: "Porter, get me another glass of ice water."

Porter: "Sorry, suh, but if I takes any more ice, dat corpse in the baggage car ain't going to keep."

* * *

"Wuz dat yo' bes' goil fren'?"

"Naw, jus' necks bes'."

* * *

Overheard on the bus after the movies—

Bus Driver: "Step right back in the bus, folks. Dinner's being served in the rear!"

Helpful Passenger: "Yeah? What's on the menu?"

Voice from the rear: "Squash!"

* * *

"Hey," cried the Devil to a new arrival, "You act as if you owned the place."

"I do," came the reply. "My wife gave it to me just before I came."

* * *

And did you hear about the little moron who struck his dentist because the old doc got on his nerves.

* * *

A man was arrainged for assault and battery and brought before the judge.

Judge: "What is your name, occupation, and what are you charged with.

Prisoner: "My name is Sparks; I am an Electrical Engineer, and I am charged with a battery."

Judge (after recovering his equilibrium): "Officer put this guy in a Dry Cell."

Engineer to roommate: "Gad! Here it is—only three in the morning, and I'm getting tired already!"

* * *

"Senator" Ed Ford: "An hallucination is like a married man getting drunk—He sees double and feels single."

* * *

A farmer and a professor were sharing a seat on a train. It was getting lonesome so the farmer started a conversation and they soon became a friendly pair.

"Let's have a game of riddles to pass the time," said the professor. "If I have a riddle you can't guess, you give me one dollar or vice versa."

"All right," replied the farmer, "but as you are better educated than I am, do you mind if I only give fifty cents?"

"O.K.," replied the professor. "You go first."

"Well, what animal has three legs walking and two legs flying?"

"I don't know. Here's a dollar. What's the answer?"

"I don't know either. Here's your fifty cents," answered the farmer.

* * *

When a pickpocket picks an engineer's pocket all he gets is practice.

* * *

A drunk was standing at a street corner mumbling to himself. A policeman nearby came up to him. As he did so, the drunk said, "It can't be done!" "It can't be done!"

"What can't be done?" said the policeman.

"Look at that sign over there," answered the befuddled toper. "It says, 'Drink Canada Dry!' "

* * *

Three students appeared at the Lehigh Station alcoholically propelled. As they reached the platform the "Black Diamond" began moving and all three staggered for it. The station cop and a porter managed to bundle two of them aboard—one on the last car—but by this time it was going too fast for the third fellow. He stood sadly on the platform watching it disappear.

"Too bad, mister," said the cop. "Wish we coulda got you aboard."

"Yes," replied the sobered Cornellian. "An' my frens'll be sorry, too. They were seein' me off!"

* * *

A dumb person can ask more questions than a smart person can answer. That is why we always flunk our examinations.

* * *

Professor: "What happens when a body is immersed in water?"

Co-ed: "The telephone rings."

* * *

A college student is like a kerosene lamp—not very bright, smokes, often goes out at night, and usually gets turned down.

* * *

"Gee! that apple had a big worm in it!"

"Here—take a drink of water to wash it down."

"Nothing doing. Let him walk."

* * *

Did you hear about the Commerce student who was so dumb that he thought a goblet was a sailor's child.

* * *

Passenger: "Conductor, does this train stop at San Francisco?"

Conductor: "Well, if it doesn't son, there is going to be one hell of a splash."

* * *

And then there was the freshman who was so dumb he thought a logarithm was a lumber camp song.

* * *

A consulting engineer is a man who knows less about your business than you do and gets paid more for telling you how to run it than you could possibly make out of it if you ran it the right way instead of the way he told you.

* * *

"Your girl is spoiled, isn't she?"

"No, it's just the perfume she's wearing.

* * *

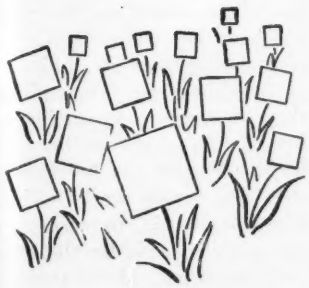
V-12: "What's Professor Vaughn talking about?"

Veteran: "Integration, you halfwit."

V-12: "Is he for it or against it?"

NUMBER 3 OF A SERIES

Newsworthy Notes for Engineers



Victory Garden of Crystals

Most synthetic crystals contain water. Under sustained operation, heat drives off the water, destroys the crystal. To lick this trouble—which put vital Navy electronic apparatus out of action, new equipment using a water-free synthetic crystal was developed by Bell Telephone Laboratories.

It was the job of engineers at Western Electric to set up equipment for *growing* synthetic crystals on a mass production basis.

For "seeds" they use tiny pieces of crystal, "planted" in metal pans. Temperature is raised to 110° F, ammonia salt solution is added, the pans are rocked gently by mechanical means. Lowering the temperature starts crystallization. After several days, the salt solution is drained. Then the process is repeated for from 45 to 60 days.

Result: synthetic crystal bars six inches to a foot in length from which the electronic crystals—better than nature's own—are cut.

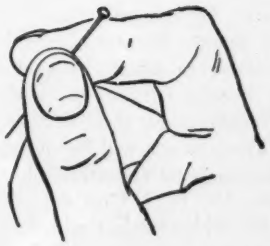
Electrical One-Way Streets

To one group of Western Electric engineers, every day is baking day. The objects of their culinary skill are copper washers and discs—from 1-16th to 1½ inches in diameter—done to a turn in a red hot oven, and with a crust of copper oxide on one side.

Piled in matched sets, these copper oxide discs are called *varistors* (variable resistors). They are high resistance in one direction, low resistance in the other, and so, in effect, allow electrical current only a one-way passage.

As radio moved into very high frequencies, specifications for precision, stability and smaller size of these rectifiers went far beyond anything previously attempted outside the laboratory.

Western Electric's manufacturing engineers set up shop for quantity production of these interesting little devices. The techniques they have developed have great significance for post-war communications.



Smaller than a Pinhead

Thermistor—thermal resistor—is the name of a class of solid variable resistors used as circuit control elements. These tiny units must be sturdy and dependable, yet extremely sensitive in response to temperature variations.

Most thermistors begin life as a metallic oxide paste. This is processed; "fired" under carefully controlled atmosphere and temperature conditions; then formed into beads on fine wires, pressed into discs or extruded as rods.

One interesting manufacturing problem arises from their size, which may be smaller than a pinhead. To manufacture these tiny devices, some of the operations must be performed under microscopes.

Developing and setting up techniques for quantity production of these precise units is another accomplishment of Western Electric engineers.

Manufacturing telephone and radio apparatus for the Bell System is Western Electric's primary job. It calls for engineers of many kinds—radio, electrical, mechanical, chemical, metallurgical. Many of the things they do —whether seemingly little or big—contribute greatly to the art of manufacture of communications equipment.

Western Electric

SOURCE OF SUPPLY FOR THE BELL SYSTEM

Atomic Energy

(*Continued from page 9*)

single V-2 bomb. No, a defense based on interception and on eliminating the launching installations is not the answer even if a complex network of radars and other defensive measures were set up all over the country. Dr. L. N. Ridenour, developer of radar systems during the war and radar advisor to General Spaatz, declares flatly in *One World or None* that "there is no such thing as a specific countermeasure against an atomic explosive or an atomic bomb."

On this question we should like to quote Dr. Oppenheimer's testimony before Senator McMahon's committee, in which he said that "Our bombs cannot be exploded before they reach their destination. . . . There never will be a counter measure against the atomic bomb." To this Dr. H. J. Curtis, leader of the Oak Ridge project added: "Nor will counter offensive warfare restore the ruins of our cities, nor revive the millions of our dead."

What Are The Alternatives?

From the previous discussion, the alternatives before us are startlingly clear. The first alternative is that we proceed apace making as many atomic bombs as possible in the next few years, and then, when we have a sufficient stock pile, launch them at the rest of the world, destroying it so completely that the United States is the master of the earth. It is hardly necessary to comment any further on this before discarding it completely.

The second alternative is that we continue bomb production and be prepared to launch the bombs at the aggressor nation or nations as soon as World War III starts. It will require only a few comments to show the sheer folly of such a course. Such a war would be initiated with the launching of atomic bombs by the aggressor nation. It takes very little imagination to see that before such a war had run its course, the world or at least most of it would be desolated. The "victor", if that word would have any significance, would be almost as completely annihilated as the defeated nation. It is clear that the destructiveness of war has, because of the development of the atomic bomb, become more than civilization can bear. Hence we must discard the second alternative.

We are inevitably led to the third alternative, namely, that a world organization be set up which will be strong enough to prevent any future war. People are not agreed as to the exact form of such an organization—some feel that the present United Nations Organization can serve in this capacity, others feel that the United Nations should be made stronger, and still others are saying that we should devote all our energies to setting up a world government. The authors are not qualified to choose the type of world organization which is fitted to the task. But it is abundantly clear that, with the threat of atomic weapons hanging over the heads of all of us on the face of the globe, it is absolutely imperative that the security of all the nations in the world be effected very shortly—in only a year or two—or else catastrophe for the United States and the world will result. This means that each nation has to be willing to delegate at least some of its sovereignty to an international body. This means that there must be effective world control of atomic energy.

We must conclude then that (1) the atomic bomb is a weapon of terrifying destructiveness (2) there is no secret of the atomic bomb; other nations can produce the bomb in about five years, (3) there is no defense against atomic explosives, for even the best defenses would allow about 10% of the explosives to reach their targets and these, because of the tremendous destructive power of atomic weapons, would wreck civilization and (4) the only alternative is peace, with world control of atomic energy such that it will be used only for peaceful purposes. And, as Raymond Swing said in his recent book *In the Name of Sanity*[3], "There is no time to lose."

What Can We Do?

The problem of securing the peace and concurrently utilizing atomic energy only for peaceful purposes seems to be a staggering one. It will require effort on the part of all of us, especially the scientists, to see to it that the problem is squarely faced, resolutely handled and permanently solved. Let us not become overwhelmed by the immensity of the problem and give up in despair. Let's see what we can do about it.

Need For Organization

First, we engineers and scientists must educate ourselves. This must be done so that we can come to intelligent and reasonable conclusions concerning the many facets of the problem—not only the scientific aspects, but also the social and the political. As we do this, we must proceed to disseminate the facts to our fellow-citizens so that they too will have an awareness of the dangers arising from the military uses of atomic energy. This will enable them to come to an intelligent understanding of the methods whereby the dangers can be resolved, so that the future world will be at peace—and not in pieces. It is necessary to consider the effect on civilization not only of atomic energy but also of many other scientific discoveries.

The problems are not easy but a lot can be done. We can do it as individuals or we can do it in groups. The groups can stem from almost any classification of people who feel responsibilities toward the welfare of mankind. They can be composed of religious workers, of educators, of social workers, of statesmen—and yes, even of scientists.

Many such groups have been formed among the scientists since August 6, 1945, first at the various sites of the Manhattan Project and shortly thereafter in many other scientific communities. All these groups were formed to consider the implications of science on world society, and how to effect the world peace. The urgency and need for such groups was emphasized by the atomic bomb.

Group Formed at Cornell

Such a group was formed at Cornell in February. It is comprised of about 150 faculty members and graduate students in the natural sciences, mathematics and engineering. The preamble to the constitution of the Association of Scientists of Cornell University states the aims of the Association.

(*Contniued on page 30*)

One of the many advantages of GAS and MODERN GAS EQUIPMENT—

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THE TREND IS TO GAS
FOR ALL INDUSTRIAL HEATING

ATOMIC ENERGY

(*Continued from page* 28)

"The value of science to humanity has never been more clear, nor have the dangers of its misuse been greater. Scientists, by virtue of their special knowledge, have in certain spheres special political and social responsibilities beyond their obligations as individual citizens. In recognition of these responsibilities, the Association of Scientists of Cornell University is formed to promote the attainment and use of scientific advances in the best interests of mankind.

"We therefore hold these aims:

1. To study the implications of any scientific discovery or development which may involve hazards to enduring peace and the safety of mankind.
2. To disseminate facts necessary for intelligent conclusions concerning the social significance of knowledge in science, and to counter misinformation with scientific fact.
3. To safeguard the spirit of free inquiry and free interchange of information without which science cannot flourish.
4. To strengthen the international cooperation traditional among scientists and to extend its spirit to a wider field.
5. In the particular field of nuclear energy, to urge that the United States aid in the initiation of an effective and workable system of world control based on full cooperation among all nations.
6. To keep our members informed on legislative proposals and political developments which affect the realization of our aims and to cooperate with other organizations in the achievements of these aims."

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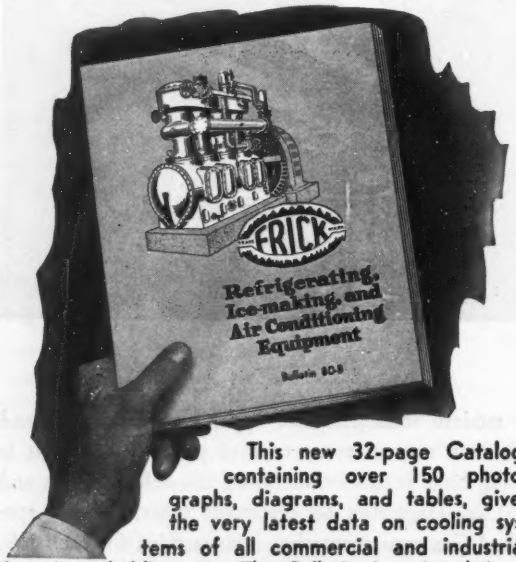

This new 32-page Catalog, containing over 150 photographs, diagrams, and tables, gives the very latest data on cooling systems of all commercial and industrial (not household) types. The Bulletin is printed in 3 colors, in full letter size, and has a durable cover. It is one of the most informative books ever published on refrigerating machinery.

If you or your friends need such equipment, ask for your copy of Bulletin 80-B, today. In writing, please describe carefully the cooling work to be done.

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We are expecting, and getting, many registrations of Cornell veterans. They are welcome.

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Teaching

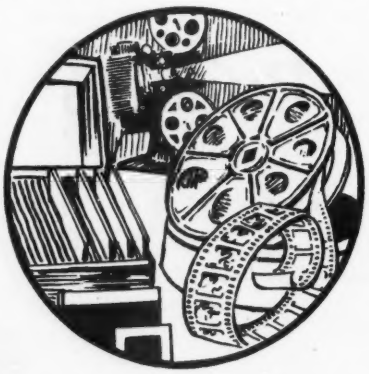
(*Continued from page* 13)

Education Department. Engineers in considerable numbers will be needed for teaching positions in these institutes. Evidence seems to point to a considerable expansion in this field of technical education, as several states are planning programs in this field.

Teaching in Engineering Colleges

For many years enrollments in colleges have been increasing. This year we have seen an unprecedented rise in applications for admission, stimulated largely by the financial aid provided for veterans who desire to continue their education. While this bulge in the enrollment curve will probably be of temporary character it is quite likely that the trend toward increased enrollments in engineering colleges will continue. This of course means that more teachers will be needed. The trend toward increasing emphasis on graduate work in engineering, indicates additional needs.

Many excellent teachers in engineering colleges never had any formal preparation for teaching in the way of professional courses in education. There appears to be increasing interest in providing opportunities for the development of engineering teachers through appropriate courses in professional education and through other means of informal character. It is hoped that before long Cornell may provide a limited number of elective courses open to senior students who may desire to look forward to careers in teaching in engineering colleges or in other schools.



Visual methods furnish the third type of aid in instruction.

The number of women who have been graduated from engineering colleges is relatively small, yet the number seems to be on the increase. The field of teaching technical subjects appears to be one toward which some women as well as men might look with interest. As yet, few women have entered this field. For the woman engineer who likes to work with people and also likes the technical field, perhaps this type of teaching may open some new possibilities.

Rewards for the Teacher

If money is the main objective of the engineer, he had best stay away from teaching. A comfortable living is usually the most one can expect in this field. But many engineers like the hours of work, the longer vacations, and the relative security that come with most teaching positions. Perhaps the greatest reward is that of the opportunity of influencing young lives, of placing imprints on young men and women who will go out from the classrooms and laboratories and make their marks in the world.

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Millions of American youngsters enjoy the delicious thrill of adventure every day with their favorite heroes of the airwaves.

And every one of them would be bitterly disappointed if anything were to interrupt the flow of electric power which makes these exciting radio dramas possible.

A minor tragedy? Of course. But an indication, nevertheless, of how much we have come to depend upon a constant, uninterrupted flow of electricity for our pleasures, our work, our health, our daily living.

Bartlett-Hayward Division of Koppers manufactures a unit which helps to assure that steady, uninterrupted flow of electric power. It's called Fast's Self-Aligning Coupling. This coupling is used to join engines to generators, generators to motors, motors to blowers and pumps and other rotating power equipment. And the coupling adjusts itself automatically to misalignments of the connected machines, so that the motors keep running smoothly and the power keeps flowing.

This coupling has done its share to make Koppers "the industry that serves all industry". Just as the designing and building of coke ovens, the production of chemicals from coal, the treating of timber, the making of roofing, paving, piston rings and many other products have played their part in helping Koppers to serve American industry and, in turn, the American public. Koppers Company, Inc., Pittsburgh 19, Pa.

The industry that serves all industry

KOPPERS

Forum

(*Conitnued from page* 15)

Judging from the fact that most companies train graduate engineers to fit their technical needs, it would seem to be a mistake to specialize on the undergraduate level. Generally, industry desires men with a sound grounding in engineering principles and the existence of the of our engineering colleges, but a "training school" is not a criticism logical extension of training leading to specialization.

It is interesting to note that those who demand more specialization on the undergraduate level in order to better prepare themselves for an industrial job are usually those who decry the merits of Liberal Arts courses. But yet they do not realize that a lack of understanding of the broader elements of society which confront him in his every-day life can hamper him more than a deficiency of some specialized bit of knowledge. Granted, a few Liberal Arts courses cannot present a complete understanding, but they can very effectively form the basis for thought and future investigation. Without the formality of teachers and classes to present the basic ideas in other fields, it is doubtful that the average person would have the incentive for further study.

In an effort to produce a more broadened engineer, Cornell University has taken the lead. Beginning in September 1946, all engineering will follow a five-year curriculum containing cultural subjects taught concurrently with the technical courses.

Air Conditioning

(*Continued from page* 16)

be bolted in the air stream before and after each unit in which the state of the air is changed. Each instrument section has an opening for a velometer tube to measure air flow rate.

Possible Operating Conditions

Regardless of the state of the air in the laboratory, different combinations of air conditioning processes may be demonstrated at any time by proper arrangement in series of the basic units. Processes which may be shown are mixing, sensible heating, sensible cooling, humidifying, dehumidifying, evaporative cooling, heating and humidifying, and cooling and dehumidifying. Each unit may serve in one combination of units to create the load for other units acting as air conditioning apparatus; in another combination, the same unit may act as the air conditioning apparatus rather than as a load. For one example, to illustrate winter air conditioning with summer air conditions prevailing in the laboratory, air may first be passed through the cooling coil or the chilled water spray chamber serving as the load. Then, the air would be drawn by the fan through one heating coil serving as a tempering coil, next through the other spray chamber spraying recirculated or heated water, and last, through the second heating coil serving as a reheater to give, finally, the required temperature and humidity of the conditioned air to be supplied to the room of the air-conditioned space. The state of the air before and after each process would be determined and the flow rate of the air through each by-pass section and through the active portion of each unit would be measured.

C R G

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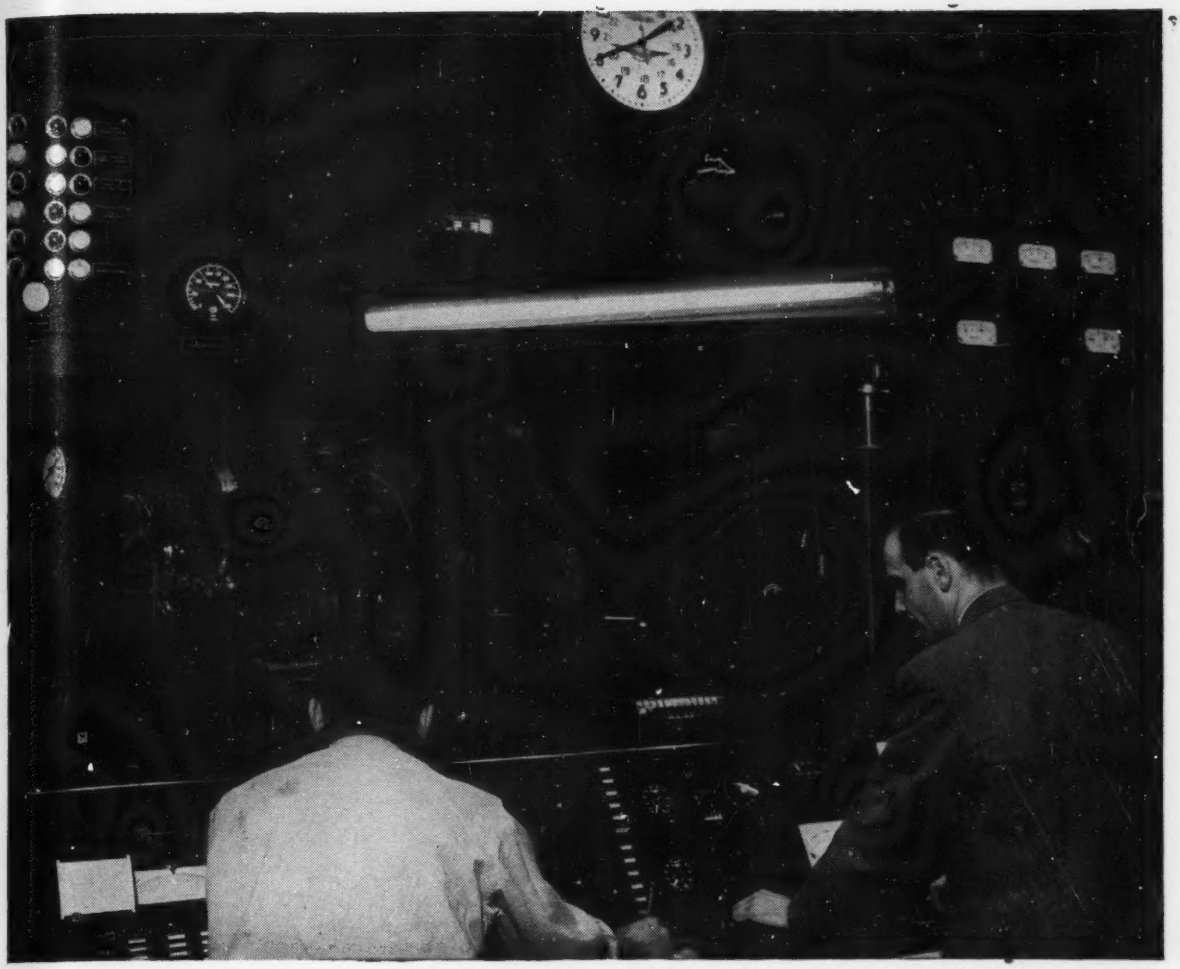

Measuring fuel performance in the Aircraft Engine Test Cell, Esso Laboratories, Bayway, N. J.

"Prove it!"

Over 2,000 research scientists and technicians are hard at work in the world's most complete petroleum laboratories – the Esso Research Laboratories! Soon the number of these research workers will be upped 20 per cent; soon close to $8,000,000 will be spent to expand those facilities.

These men and these facilities have just one job – *to develop continually finer fuels, lubricants and chemical products from petroleum.*

But their discoveries and their recommendations for improvements must be *tested* and *proved* before they can be put in effect.

That is why, for instance, a half-million-dollar aircraft engine test cell, more modern than any other in America, has been built at the Esso Research Laboratory. Here aircraft engines are run to death, *not* to test the engine—but to test the fuel. This test cell will handle everything up to 3,000 horsepower. And its equipment is the finest throughout – from its vibration-proof control room floated on cork to its 50,000 cubic feet per minute exhaust fan. Controls are electronic, tempered air for carburetion is supplied at 4 in. mercury pressure. Instead of the normal 4 or 5 checks there are 186 points for temperature determination.

Research like this has helped win for Esso products their reputation for quality and dependability.

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Roebling produces every major type of wire and wire product . . . house wire to telephone cable . . . bridge cable to wire rope . . . fine filter cloth to heavy grading screen . . . strip steel and flat wire to round and shaped wire . . . all Roebling products. *All* the result of over 100 years of wire specialization.
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Administrative Engineering

(*Continued from page* 11)

each of three courses. In any case, the program will not force the student to concentrate in only one phase; it is designed to be more general.

Student Project

All of the training during the first 4½ years acts as a basis for the six-hour project of the student's last term. This will be a problem in the special field the student has chosen for his nine-hour elective and will be taken from an actual plant. If no special field has been chosen (i.e. general electives have been chosen), the project also can be general. In order to determine the problem and its solution, the student will, in many instances, go directly to the plant as the best means of becoming familiar with the complete set-up. The purpose, of course, will be to coordinate all the basic material which the student has considered in previous semesters.

The Industrial Department, naturally, does not plan to give all the courses outlined above itself. Labor Relations will be given in the Industrial & Labor Relations School, Economics in the Arts School, Industrial Design in the School of Architecture, etc. One thing that may be puzzling you is the elective known as Teaching. This, believe it or not, will be a series of courses designed to teach a student about industrial education.

Future

Thus, what we have here are the plans for one of the foremost industrial and engineering administrative schools in the world. Professor Loberg has an excellent base upon which to work; thus far he has done well. He has given us a program which will guide a man and yet not be too specific. This program will help the man who knows what he wants to go into and will direct him. Developing a certain amount of independence, it will still tell him generally what courses he should take. Professor Loberg is third in a line of leading industrial educators at Cornell, Dean Kimball and Professor Bangs preceding him. Here's hoping that the results will be as bright as his plans envisage them.

THE FLAME THAT CUTS *through Sea and Steel*

Men-of-war that "died" at Pearl Harbor lived again to fight at Omaha beach and Leyte. No small measure of credit for their resurrection belongs to the modern techniques of underwater cutting with the oxy-hydrogen flame and underwater welding with the electric arc. These methods are serving the nation's needs in wartime, and are also opening the way to new peacetime accomplishments in submarine salvage and construction.

Air Reduction has played a leading part in designing and manufacturing equipment for underwater cutting, as part of its program of progress which has given the world many new developments in welding, cutting and other related methods for modern metal-working.

The operating subsidiaries of Air Reduction Company, Inc., are:

AIR REDUCTION SALES COMPANY
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International Sales Representatives of these Companies

AIRCO **AIR REDUCTION**
60 East 42nd Street, New York 17, N. Y.

Ralph C. Kelley

(*Continued from page* 18)

about ten dollars worth of chemical was flowing down the drain, the boss was hollering for the analyses, and the furnace divisions were hollering at the boss. It was a ticklish situation and would have been extremely embarrassing for Ralph if he hadn't rushed through another, and more successful, batch.

The V-12 happened along at a very opportune time for Ralph. On the same day that he took his V-12 examination, he received the greetings of the President. The draft board felt the same way about college that Ralph did, however, and granted him a sixty day deferment. Subsequently, he was accepted and chose Cornell.

The college of his first choice, naturally enough after just leaving a chemical plant, was the chemical engineering school. But the Navy had other ideas, and Ralph declares that the least of all the evils presented was electrical engineering. Thus, he is now aiming for a B.S. in EE.

At the present time he is handling the finances of the graduating class. Last term he was co-secretary with Marcia Noyes of the February graduating class. His reputation as a secretary is evidently well established, because he held the position in his fraternity, Lambda Chi Alpha, for two terms, and had the same job in the Corinthian Yacht Club last term. He has also served as social chairman of his house and participated on the social committee in Willard Straight Hall.

Ralph is looking forward to a long vacation in Minnesota with his parents this summer. "This time I'm going to catch some fish, or bust tryin'," he says. We surely wish him good luck.

J. P. Craven

(*Continued from page* 19)

Now in his last term at Cornell "J. P." goes the way of all who enter in with the thirst for knowledge. Only John wasn't selfish about it. While he is gaining the knowledge that will serve him the rest of his life he is giving much to his school and to all who know him.

M. S. Gross

(*Continued from page* 19)

fied a navigator. Then came the travel, the constant change of training locations—Florida, Louisiana, then reassignment and combat crew training in Walla Walla, Washington. Somewhere along the line Milt was promoted to a first lieutenant. He navigated a B-24, and flew for the ATC out of Mitchell Field, where war-weary planes were picked up and flown into the interior. Milt's last assignment for the AAF was metereology at Chanute Field. His Army career ended when he became a veteran in October, 1945. With his senior year to complete, he again registered at Cornell in November, 1945. This June Milt is getting his M.E. degree. His future plans are not definite; but they certainly include work in industry, and perhaps work for an Arts degree later, carrying out his original intention of a six year liberal Arts-Engineering course.

Milt's pre-war college activities included Round-table (faculty-student discussion group), lighting for

(*Continued on page* 40)

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We can offer the Services of our Experienced Construction Personnel to help you Design, Prepare both budget and bid Estimates, and Build in this Post War Period

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ATTENTION ENGINEERS

The Bureau of Aeronautics, Navy Department, Washington, D. C., is seeking Engineers in the fields listed below for civilian positions.

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Ring Around Bossy!

The ring you see around Bossy is a ring of protection guarding her milk from the moment it is received until it reaches your doorstep . . . sweet, farm-fresh, and cold!

Borden, Sheffield and many another of America's famed milk producers have called on "Headquarters for Mechanical Cooling" not only for dependable equipment—but also for the specialized engineering knowledge and intimate understanding of the dairy industry which is uniquely York's.

For instance, a York contribution which has materially helped the milk business reach its present peak efficiency is High-Temperature Short-Time Pasteurization. This process is the result of intensive study, research, and experimentation extending over a period of many years.

Throughout the nation this York equipment is processing the huge total of 9,772,540 quarts of milk per day!

Not only in the dairy industry but also in the field of fast freezing and in the storage and wider distribution of refrigerated foods, York is supplying the engineering and manufacturing skill necessary to make us a healthier, better-fed nation.

York Corporation, York, Pennsylvania.

YORK *Refrigeration and Air Conditioning*

HEADQUARTERS FOR MECHANICAL COOLING SINCE 1885

M. S. Gross

(*Continued from page* 38)

the dramatics club, and track. This year he spent most of his time on the *Cornell Engineer* and also worked as a member of the Spring Day Carnival Committee.

Lately Milt has been looking a bit hunted; he's been afraid some of the *Engineer's* readers will start throwing old tomatoes at him because of his humor column, "Decitrig Duplexities." A humor article is a new venture for Milt, and in spite of his misgivings, "Duplexities" has been very well received.

His many friends, especially those who work with him, will tell you that Milt is the man to see for sound advice and organizational help. Perhaps it's not right to make predictions about someone's future life; but without reference to the crystal ball we think Milt will make a success of whatever projects he chooses to undertake.

CORRECTION

In the March issue the co-author of "The Engineer's Role in Railroads" is Mr. A. R. Ayers, ME 1900.

Techni-briefs

(*Continued from page* 23)

of the flight show that all of the planes, at times, made sustained speeds of more than 625 miles an hour. One of them is believed to have passed the 700 mile an hour mark while flying smoothly at 43,000 foot altitude.

One of the top advantages of the new jet engines is that they can be harnessed either to drive planes at peak speeds with jet thrust or to drive a propeller and give jet boost simultaneously. These new type engines cruise at near maximum speed. That means that high speeds can be maintained by planes powered by them. In addition, the gas turbine jets and Propjet engines perform most efficiently from the standpoint of fuel consumed and distance covered while operating at high speed and high altitudes.

The Jets that powered the P-80's on the flight were regular production engines, and none of them were "souped up" in any way for the cross country performance test. This type of jet produces 4,200 pounds of thrust, and is more powerful than any reciprocating engine in the air today. Kerosene is the fuel used in these jet engines.

Colonel Councill and the other two AAF pilots making the record flights reported that the jet engines made virtually no vibration, even when the power units were driving the planes at tremendous speeds. Also, a person sitting in a jet plane hears no noise from the engine.

The new power plants have been proved both for speed and sustained operation, and larger units will be developed as the demand for these light and tremendously powerful gas turbines grows.

Glove Tester

THE glove tester, or "liquid hand," consists mainly of a high voltage power supply and a water tank large enough to accommodate a lineman's "clothesline" of a dozen gloves. The gloves are filled with water, then immersed into the water tank deeply enough so that only the cuffs remain above the surface.

An electrical circuit is established from power supply to water inside

(*Continued on page* 44)

Okonite's general catalog on wires and cables contains information on conductors and coverings, materials and fabrications, and a selector chart. Engineering students may obtain a free copy of this booklet by writing for Bulletin OK-1011. The Okonite Company, Passaic, New Jersey.

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INSULATED WIRES AND CABLES
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We're not trying to sell,
We're trying to buy—

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DRAWING INSTRUMENTS
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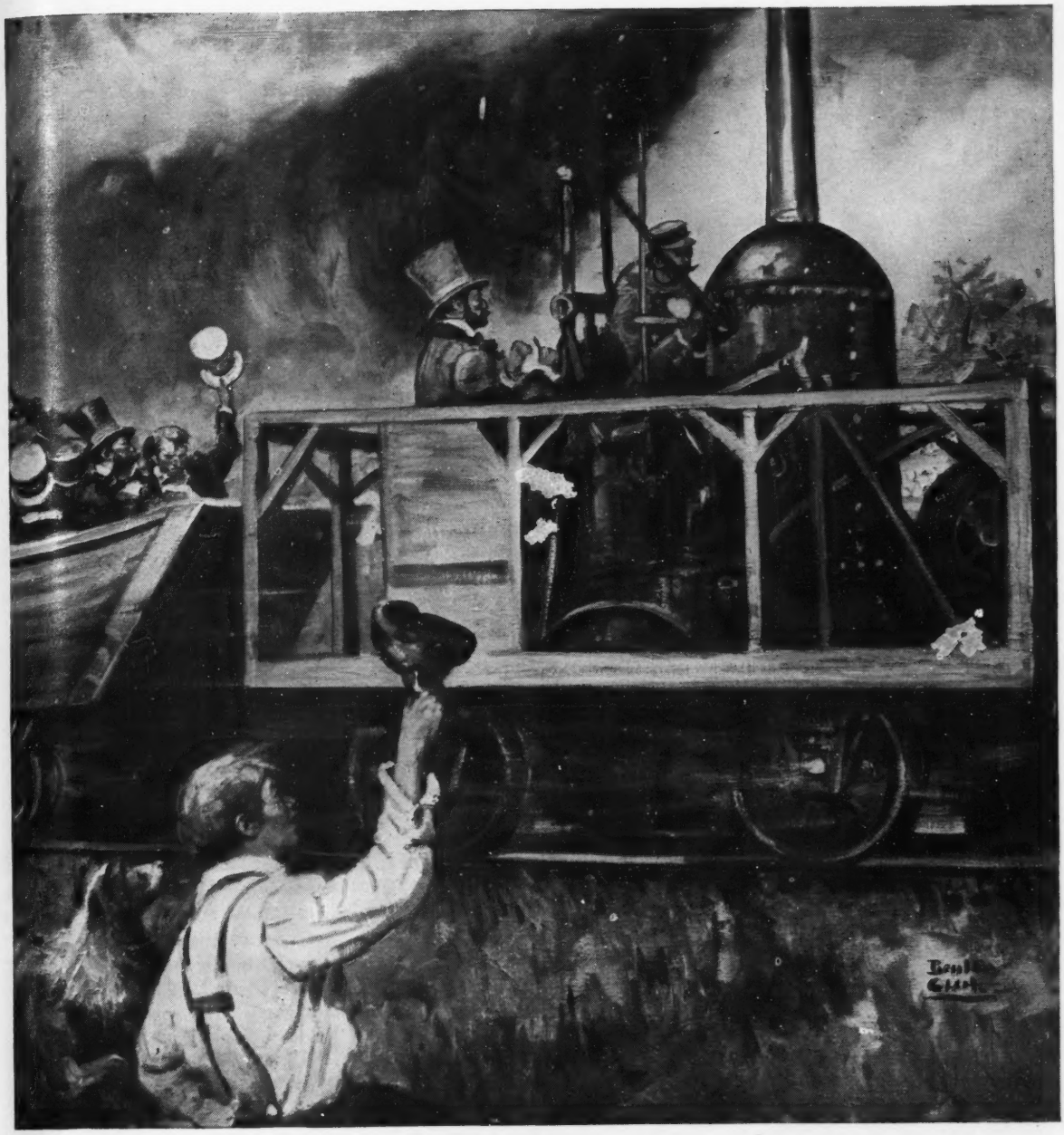
All indications point to a severe shortage of these items next fall. Sell now, get high prices and help out some other Cornell student next fall.

THE CORNELL CO-OP

Barnes Hall — On The Campus



The "TOM THUMB"

This was the first American locomotive. It was built in 1830 in a coachmaker's shop in Baltimore by Peter Cooper, an imaginative merchant. The flues of its boiler were old musket barrels, and its smokestack looked "like an aggravated putty-blower." On its first run — to Ellicott's Mills, with one car attached — it made as much as eighteen miles an hour going down hill. Some of the passengers took out their notebooks and jotted down sentences, to prove that it was possible to do so while traveling at such tremendous speed.

A century later came America's first streamlined train. Its journals were equipped with SKF Bearings. Pioneering for years in the railroad industry, SKF Bearings had already proven themselves by millions of miles of successful service under the most rugged conditions. Today SKF Bearings are an accepted standard for journals, for generators and for driving motors on the railroads of the nation. Since SKF makes so many types of anti-friction bearings, an SKF engineer can give you expert help in selecting

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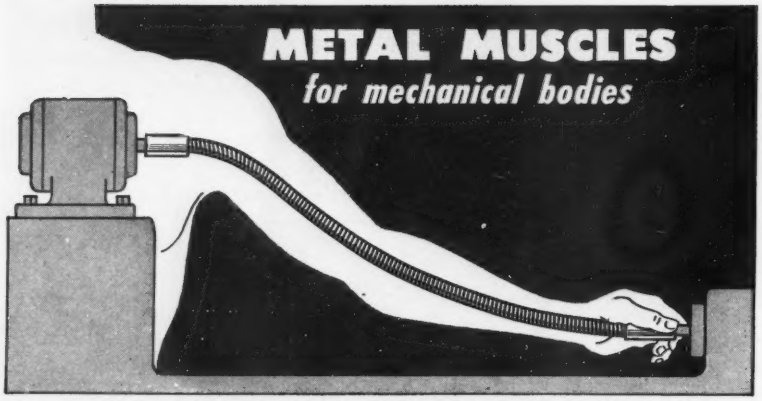
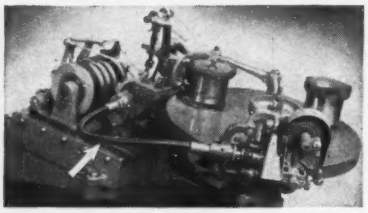
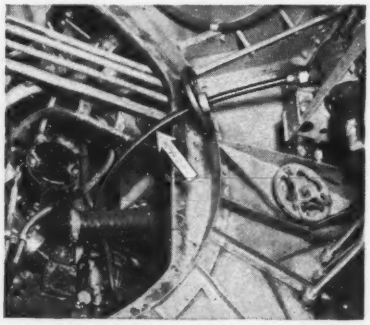


S.S.WHITE FLEXIBLE SHAFTS



In this machine a flexible shaft (arrow) takes power from the main drive and carries it around a right angle turn to drive an auxiliary mechanism. Compare the simplicity of this arrangement with any other possible means of doing this job.



In this application on a large airliner, the flexible shaft takes power from the engine to drive the electric tachometer generator at the upper right. It typifies the ready adaptability of flexible shafts for all kinds of drives.

are metal muscles expressly created for performing two functions in mechanical bodies:

(1) Transmission of rotational power.
(2) Mechanical remote control.

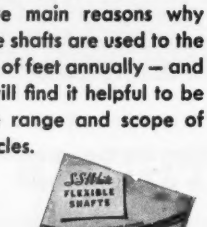
S.S.White flexible shafts offer such important advantages that it will pay to consider their use every time a power drive or remote control problem comes up in engineering design.

Suppose, for example, you have to transmit power from one part of a machine to another where a straight line drive is not practicable. The fewest parts with which it can be done is an S.S.White flexible shaft — a single mechanical element that will provide a positive drive between practically any two points, regardless of turns, obstacles or distance.

This basic simplicity, plus their ready adaptability to a wide range of power drive and remote control conditions and requirements, are main reasons why S.S.White flexible shafts are used to the extent of millions of feet annually — and why engineers will find it helpful to be familiar with the range and scope of these Metal Muscles.

WRITE FOR BULLETIN 4501

This bulletin will give you the basic information and technical data about flexible shafts and their uses. A copy is yours for the asking. Please mention your college and course when you write.



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College News

(*Continued from page* 17)

"Advances in the science of vision were stimulated during the war period by the problems presented in this field," according to Dr. Walter R. Miles, professor of psychology in the School of Medicine, Yale University, who gave an illustrated lecture "The Expanding Horizon in Visual Research," in Olin Hall recently.

The varied aspects and importance of visual research are indicated in the following information from an abstract by Dr. Miles.

"As good, well trained eyes are an important peacetime asset as well as a military necessity, results of war research in vision will have widespread application," states Dr. Miles. As an example, a new development called the fusion-density goggles produced at Yale University, enables observers to search the sun and also the sky immediately surrounding the sun for the silhouettes of planes.

Guiding the use of a 200 ampere electric welding arc constitutes a visual task involving similar hazards to the eyes to that of searching the sun for plane silhouettes. Dr. Miles explains how the fusion-density device is now adapted to the task of welding making possible the inspection of the deposited pool of metal while the arc is lighted, greater control of visual surroundings, and less accident hazard.

"Another phase of visual research is in the effect of lighting on sight," states Dr. Miles. In searching for military targets, it was necessary to use the eyes under the two most extreme conditions of lighting: that of looking into the black night, and looking into the face of the sun. Some advances were made in night vision, among them a training procedure to prepare for night lookout duty, and the discovery of the long and accumulative after effects of semi-tropical sunshine in causing the deterioration of night vision. This latter discovery greatly stimulated the adoption of sun glasses transmitting no more than 15 per cent of the light and enforced the importance of wearing such protective glasses.

RCA airborne television will bring you thrilling news events that could not otherwise be "covered"—while they are happening.

You'll see news in the making—through Television

Imagine! A helicopter is "covering" the story of a man marooned on a burning building. Sitting at your home television receiver, you will get the same eye-witness view as though you were riding along in the nose of the plane!

To develop equipment compact enough to fit into a plane was a major problem. But RCA-NBC scientists and engineers in co-operation with the U. S. Navy did it—and airborne television became a wartime reality.

This portable equipment has many peacetime uses—and may lead to development of a "walkie-lookie" with which a radio or news reporter might cover a story by television as readily as a news photographer does now with a camera.

Such progress-making research goes into each and every RCA product—and is your assurance that anything bearing the RCA or RCA Victor emblem is one of the finest instruments of its kind that science has achieved.

• • •

Radio Corporation of America, RCA Building, Radio City, New York 20...Listen to The RCA Victor Show, Sundays, 4:30 P.M., Eastern Standard Time, over the NBC Network.

A television "eye" in the nose of a plane! Besides covering news events by plane, automobile or boat, such revolutionary equipment developed by RCA and NBC, can make accurate geographical surveys from planes flown by remote control. Moreover, similar television equipment can observe hazardous manufacturing processes from a safe distance.

RCA **RADIO CORPORATION of AMERICA**

Techni-briefs

(*Contniued from page* 40)

the gloves by means of a conductor. A milliameter is readied to register any current that might pass from water inside the gloves to water outside the gloves in the tank.

If the milliameter indicates any current leakage to water outside, the glove is proved to be defective and thus ready for discard or repair. If the milliameter registers no current in the water outside the glove, proof is established that the glove has insulation at all points ample enough to keep the current from passing through and to insure the lineman of safety from shock.

The glove testing device is designed for use by manufacturers so they can test gloves before shipment and also by concerns using the gloves so they can conduct periodic as a safety precaution.

New Plastics

POLYTHENE, a chemically inert thermoplastic developed during the war, is the lightest thermoplastic commercially produced. It is admirably suited for insulation of wire for high-frequency current, where its low electrical losses and general physical and chemical characteristics are unequaled by any other material. Its water absorbtion is less than 0.005%. It is being and will be used in television cables, as containers for highly corrosive chemicals, as a packaging material, and for shower curtains, umbrella coverings, and other articles.

Another newcomer is nylon for use as a plastic. Nylon offers unusual toughness and a high service temperature, which permits steam sterilization. In addition, it retains its impact resistance at extremely low temperatures. Nylon has been used for electrical coilforms in telephone headsets, and is being used today in tumblers, tableware, slide fasteners, and combs. A whole new field of use for nylon is in extrusion jacketing of insulated wire, where it contributes resistance to abrasion, to gasoline and other organic solvents. There are now five formulations of nylon to furnish different properties and characteristics for different requirements.

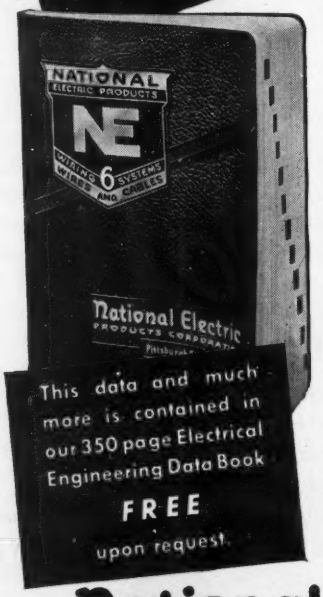
Tapered nylon bristles are used for paintbrushes. When the war began, they had not been perfected; today they have years of service behind them. Repeated tests show that nylon bristles, tough and resilient, possess a combination of advantages unobtainable in any other type of bristles—and they outwear the best hog bristles from three to five times.

Induction Heating

The new technique which employs high frequency radio waves to generate heat in the work by agitating its molecular structure, is equally adaptable to either natural or synthetic rubber, Firestone Chairman John W. Thomas declared.

"It is six times as fast as present methods of steam curing and all-oven drying," he explains, "and turns out better products because its heat is generated uniformly throughout the work and is more easily controlled. In addition, high frequency action bonds the sulphur and rubber molecules more completely, giving a better cure or vulcanization."

answers to questions on:



- Housing wires and cables in walls and floors.
- Surface housing of wires on ceilings, walls and floors with greatest efficiency and neatness.
- How to eliminate enclosed branch circuits with limited outlets in homes and provide maximum access for fixtures.
- Wires and cables to suit every industrial, commercial and domestic power requirement.

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OIL BURNER NOZZLES which retain constant orifice size and resist the deposition of carbon on their highly polished surfaces.

BURNISHING WHEELS which produce high polish on non-ferrous metals.

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1. Hardness = 9 Mohs' scale
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7. Can be bonded to metals
8. Economical flame-fabrication in rod form

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Alumni News

(*Continued from page 20*)

battery sales in addition to industrial truck and locomotives sales at the New York branch. He and his family live in Thomaston, Great Neck, of which he has been mayor for the past seven years.

DR. EARL W. PHELAN '21 B.Chem., '28 Ph.D., professor of chemistry at Georgia State Women's College, has been on leave for several years with the U. S. Office of Scientific Research and Delevelopment. It is expected that he will resume his position in September. At present he may be addressed at Room 10-212, Massachusetts Institute of Technology, Cambridge 39, Mass.

EUGENE ODIN '27 M.E.; '14 M.E., senior engineer with Arma Corp., 254 Thirty-sixth Street, Brooklyn, was recently awarded the Bureau of Ordnance Certificate for Distinguished Service to Naval Ordnance Development. He was recognized for his work in the development and design of gun fire control equipment for the Navy. During the war, the Arma Corp. received the Army-Navy "E" with six stars. George O. Kuhle, '14 M.E. is secretary of the company.

F. WELLS SHOEMAKER, '44 B.S. in Chem.E., was released from the Navy March 19, and shortly afterwards joined American Enka Corp., producers of rayon yarn, as junior assistant chemical engineer at the company's pilot plant.

LIEUTENANT ALFRED H. SILVER, AUS, '44 B.M.E., is custodian of Class C war criminals now on trial at the Yokohama courthouse. His address is PM Section 8th Army, APO 343, care of Postmaster, San Francisco, Calif.

CALVIN G. BROWN '45 B.S. in C.E., Company B, 8th Battalion, TLS, ASFTC, Fort Belvoir, Va., writes: "On completion of basic training, delayed by two sojourns in the hospital, I am starting training preparatory to OCS. Activity here is tremendous, with promise of record-breaking number of personnel, the number now at the 23,000 mark."

DUDLEY S. KING '27, '30 M.E., is assistant chief engineer for the Lycoming Division, Aviation Corp., Williamsport, Pa.

J. ALBERT WOOD, '28 E.E., '35 Ph.D., formerly assistant director of the radar school at MIT joined the Thayer School faculty of Dartmouth College, Hanover, N. H., as assistant professor of electrical engineering. As part of his duties, he supervises the installation of new electrical equipment and directs the electronics work in the school's new electrical engineering course.

CHARLES E. HUDDLESTON '29 M.E., is chief engineer for Blaw-Knox Co., Martins Ferr, Ohio, division. Blaw-Knox manufactures machinery and steel products.

WALTER C. KNOX, '29 C.E., assumed the duties of office engineer on the Altoona Dam project at Cartersville, Ga., on May 1. The dam is to be constructed under the supervision of Mobile, Ala., Engineer District. He may be reached at U. S. Engineer Office, Cartersville, Ga.

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The picture that sold a lot of dresses . . .

THIS isn't a fashion picture today, nor was it in 1896 when it appeared in newspapers all over the world. But this picture prompted a London department store to take advantage of the occasion by advertising and selling "x-ray proof dresses."

It was also reported that x-rays would be used by medical colleges to implant anatomic diagrams directly into the brains of future doctors. And some people suggested the whole business be forgotten before the new rays brought about the total destruction of mankind.

Such was the popular reception accorded Roentgen's discovery of the x-ray 50 years ago. Few people, even scientists, could foresee that within a half century this discovery would become a major weapon against disease, and an industrial tool that would help win World War II.

Corning first appeared in the "x-ray picture" some 30 years ago, when the development of this science seemed to be reaching its limit unless tubes could be produced of a glass capable of high transmission of x-rays and capable of withstanding extreme heat and high voltages for long periods of service. Here is where Corning skill was instrumental in furnishing bulbs to x-ray tube manufacturers, just as it has furnished glass with special properties for countless other fields . . . all the way from elaborate laboratory apparatus to glass cooking utensils, from giant airway beacon lenses to an all-glass pump for handling corrosive acids. Corning, with its years of experience, is anxious to help you learn all about glass today. For tomorrow, that knowledge will come in handy on your new job. Why not write us? Corning Glass Works, Corning, N. Y.

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